HOSPIRA

TECHNICAL SUPPORT OPERATIONS

ELECTRONIC TECHNICAL SERVICE MANUAL

LifeCare PCA3

Infusion System

EPS-04566-003 (REV. 1/05)

Hospira

LIFECARE®
PCA3

Infusion System

For use with list number 12384-04

Technical Service Manual

Hospira

430-04566-003 (Rev. 1/05)

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Section 1

INTRODUCTION

The LifeCare® PCA 3 Infusion System is a patient-controlled analgesia management system designed to meet the fluid delivery requirements of today's evolving healthcare environments. The system is comprised of a pole mounted or tabletop drug infusion pump (PCA 3), drug vials with a variety of pre-filled drugs and drug concentrations (PCA 3 vial), and an administration set (PCA 3 set).

The PCA 3 pump is a self-contained, microprocessor-based infusion device with keypad controls; a prompting alphanumeric display; an LED display; an integral locking system; a pole clamp; a barcode reader for drug identification; field-upgradeable software; and a connector for a DataPort, which includes inputs and outputs for devices such as a computer or printer. The pump is intended to operate on AC power. An internal battery is provided to maintain operation for short periods of time during patient transport and when AC power is lost or not available.

1.1 SCOPE

This manual is organized into 11 sections:

- Section 1 Introduction
- Section 2 Warranty
- Section 3 System Operating Manual
- Section 4 Theory of Operation
- Section 5 Maintenance and Service Tests
- Section 6 Troubleshooting
- Section 7 Replaceable Parts and Repairs
- Section 8 Specifications
- Section 9 Drawings
- Index
- Technical Service Bulletins

If a problem in device operation cannot be resolved using the information in this manual, contact Hospira *(see Section 6.1, Technical Assistance)*.

Specific instructions for operating the device are contained in the *PCA 3 System Operating Manual*. Provision is made for the inclusion of the system operating manual in *Section 3* of this manual.

Note: Figures are rendered as graphic representations to approximate actual product; therefore, figures may not exactly reflect the product.

1.2 CONVENTIONS

The conventions listed in *Table 1-1, Conventions*, are used throughout this manual.

Table 1-1. Conventions

Convention	Application	Example
Italic	Reference to a section, figure, table, or publication	*(see Section 6.1, Technical Assistance)*
[ALL CAPS]	In-text references to keys and touchswitches	[SILENCE]
ALL CAPS	Screen displays	LOW BATTERY
Bold	Emphasis	**CAUTION: Use proper ESD grounding techniques when handling components.**

Throughout this manual, warnings, cautions, and notes are used to emphasize important information as follows:

WARNING: A WARNING CONTAINS SPECIAL SAFETY EMPHASIS AND MUST BE OBSERVED AT ALL TIMES. FAILURE TO OBSERVE A WARNING IS POTENTIALLY LIFE THREATENING.

CAUTION: A caution usually appears prior to a procedure or statement. A caution contains information that could prevent irreversible equipment damage or failure.

Note: A note highlights information that helps explain a concept or procedure.

1.3 COMPONENT DESIGNATORS

Components are indicated by alpha-numeric designators, as follows:

Battery	**BT**	Diode	**D**	Resistor	**R**
Capacitor	**C**	Fuse	**F**	Switch	**SW**
Crystal	**Y**	Integrated Circuit	**U**	Transistor	**Q**

The number following the letter is a unique value for each type of component (e.g., R1, R2).

Note: Alpha-numeric designators may be followed with a dash (-) number that indicates a pin number for that component. For example, U15-13 is pin 13 of the encoder chip [U15] on the interface PWA.

1.4
ACRONYMS AND ABBREVIATIONS

Acronyms and abbreviations used in this manual are as follows:

A	Ampere
AC	Alternating current
ADC	Analog-to-digital converter
BCR	Barcode reader
CMOS	Complementary metal-oxide semiconductor
CPU	Central processing unit
dB	Decibel
DC	Direct current
DPM	Digital pressure meter
DSLR	Display start line register
ECG	Electrocardiograph
EEG	Electroencephalogram
EMG	Electromyogram
EMI	Electromagnetic interference
EPROM	Erasable/programmable read-only memory
ESD	Electrostatic discharge
ETO	Ethylene oxide
hr	Hour
Hz	Hertz
ID	Identification
I/O	Input/output
IPB	Illustrated parts breakdown
IV	Intravenous
lbs	Pounds
LCD	Liquid crystal display
LED	Light emitting diode
mA	Milliampere
mcg	Microgram
MCU	Microcontroller unit
mg	Milligram
mL	Milliliter
MPU	Microprocessor unit
ms	Millisecond
ns	nanosecond
N/A	Not applicable

PCL	Power control logic
psi	Pounds per square inch
PVT	Performance verification test
PWA	Printed wiring assembly
RAM	Random access memory
ROM	Read only memory
RTC	Real-time clock
SLA	Sealed lead acid
SPDT	Single pole double throw
SPI	Serial peripheral interface
SRAM	Static random access memory
UART	Universal asynchronous receiver transmitter
V	Volt
$\mathbf{V_{AC}}$	Volts alternating current
$\mathbf{V_{CC}}$	Collector supply voltage
$\mathbf{V_{DC}}$	Volts DC
WDI	Watchdog input
μA	Microampere
μV	Microvolt

1.5
USER QUALIFICATION

The PCA 3 infusion pump is intended for use at the direction or under the supervision of licensed physicians or certified health care professionals who are trained in the use of the pump and the administration of parenteral and enteral fluids and drugs, and whole blood or red blood cell components. Training should emphasize preventing related IV complications, including appropriate precautions to prevent accidental infusion of air. The epidural route can be used to provide anesthesia or analgesia.

1.6
ARTIFACTS

Nonhazardous, low-level electrical potentials are commonly observed when fluids are administered using infusion devices. These potentials are well within accepted safety standards, but may create artifacts on voltage-sensing equipment such as ECG, EMG, and EEG machines. These artifacts vary at a rate that is associated with the infusion rate. If the monitoring machine is not operating correctly or has loose or defective connections to its sensing electrodes, these artifacts may be accentuated so as to simulate actual physiological signals. To determine if the abnormality in the monitoring equipment is caused by the pump instead of some other source in the environment, set the pump so that it is temporarily not delivering fluid. Disappearance of the abnormality indicates that it was probably caused by electronic noise generated by the pump. Proper setup and maintenance of the monitoring equipment should eliminate the artifact. Refer to the appropriate monitoring system documentation for setup and maintenance instructions.

1.7 INSTRUMENT INSTALLATION PROCEDURE

CAUTION: Infusion pump damage may occur unless proper care is exercised during product unpacking and installation. The battery may not be fully charged upon receipt of the infusion pump. Do not place the infusion pump in service if it fails the self test.

CAUTION: Infusion pump performance may be degraded by electromagnetic interference (EMI) from devices such as electrosurgical units, cellular phones, and two-way radios. Operation of the infusion pump under such conditions should be avoided.

The instrument installation procedure consists of unpacking, inspection, self test, and setting the time and date.

Note: Do not place the infusion pump in service if the battery is not fully charged. To make certain the battery is fully charged, connect the infusion pump to AC power for 24 hours *(see Section 8, Specifications)*.

1.7.1 UNPACKING

Inspect the infusion pump shipping container as detailed in *Section 1.7.2, Inspection*. Use care when unpacking the infusion pump. Retain the packing slip and save all packing material in the event it is necessary to return the PCA 3 to the factory. Verify that the shipping container contains a copy of the system operating manual.

1.7.2
INSPECTION

Inspect the infusion pump shipping container for shipping damage. Should any damage be found, contact the delivering carrier immediately.

CAUTION: Inspect the infusion pump for evidence of damage. Do not use the pump if it appears to be damaged. Should damage be found, contact Hospira *(see Section 6.1, Technical Assistance)*.

Inspect the infusion pump periodically for signs of defects such as worn accessories, broken connections, or damaged cable assemblies. Also inspect the infusion pump after repair or during cleaning. Replace any damaged or defective external parts.

1.7.3
SELF TEST

CAUTION: Do not place the infusion pump in service if the self test fails.

To perform the self test, refer to *Figure 1-1, PCA 3 Self Test Screens*, and proceed as follows:

1. Unlock and open the security door.
2. Plug the AC power cord into a grounded, hospital grade, 120 V_{AC}, 50-60 Hz receptacle. Verify the AC plug indicator on the front panel is illuminated.
3. Press [ON/OFF] to turn the power on. The pump will perform a self test verifying the integrity of the software, memory, and selected electronic functions.
4. Verify the time and date. To set the time and date, refer to *Section 1.7.4, Setting the Time and Date*.

   Note: If the quality of earth grounding source is in doubt, use battery power.

   Note: When the AC plug indicator is off and the battery indicator on the display is flashing, this is an indication that the PCA 3 is operating on low battery power and should be recharged.
5. To confirm the battery is charged before placing the pump in service, plug the AC power cord into hospital grade 120 V_{AC} and charge for 24 hours.

Note: If an alarm condition occurs during the self test, press [ON/OFF] twice and repeat the self test. If the alarm condition recurs, note the message and take corrective action *(see Section 6, Troubleshooting)*. Repeat the self test. If the alarm condition recurs, remove the PCA 3 from service and contact Hospira.

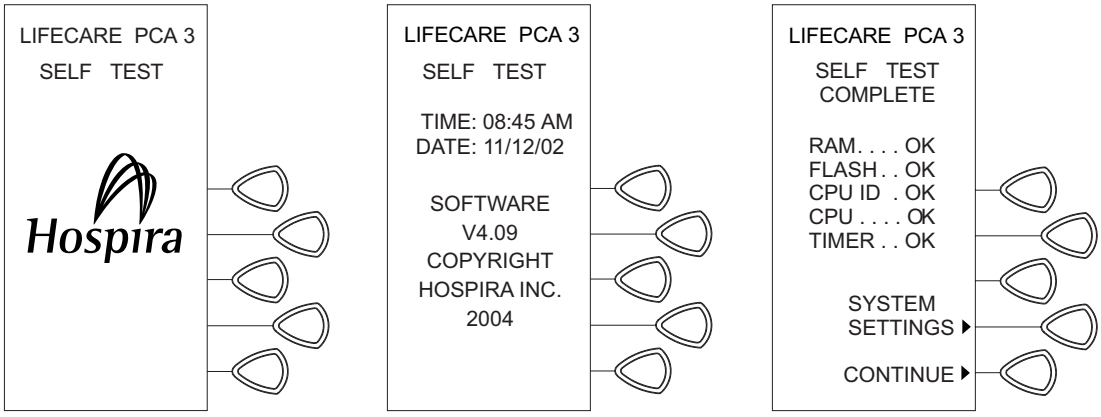

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Figure 1-1. PCA 3 Self Test Screens

1.7.4
SETTING THE TIME AND DATE

To set the time and date, refer to *Figure 1-1, PCA 3 Self Test Screens* and *Figure 1-2, Setting the Time and Date*, and proceed as follows:

1. Unlock and open the security door.
2. Press [ON/OFF] to turn the power on. Wait for the **SELF TEST COMPLETE** screen to appear.
3. Press the [SYSTEM SETTINGS] softkey.
4. Press the [TIME/DATE] softkey. A **WARNING** screen appears.

   Note: Changing the time or date will clear all totals.

5. Press the [CONTINUE] softkey.
6. Set the time using the keypad touchswitches. Press the [AM/PM] softkey to toggle AM/PM.

   Note: AM/PM option is available only in 12-hour clock format.

7. Press the [NEXT] softkey to continue.
8. Set the date using the keypad touchswitches.
9. Press the [NEXT] softkey.
10. Press the [CONFIRM] softkey to accept current time and date settings or press [CHANGE] to change time or date settings.
11. Verify the **SAVING DATE AND TIME** screen is displayed. Press the [CONFIRM] softkey.
12. Verify the **SELECT SETTING TO CHANGE** screen is displayed.

13. Press the [ON/OFF] softkey when correct time and date are displayed.

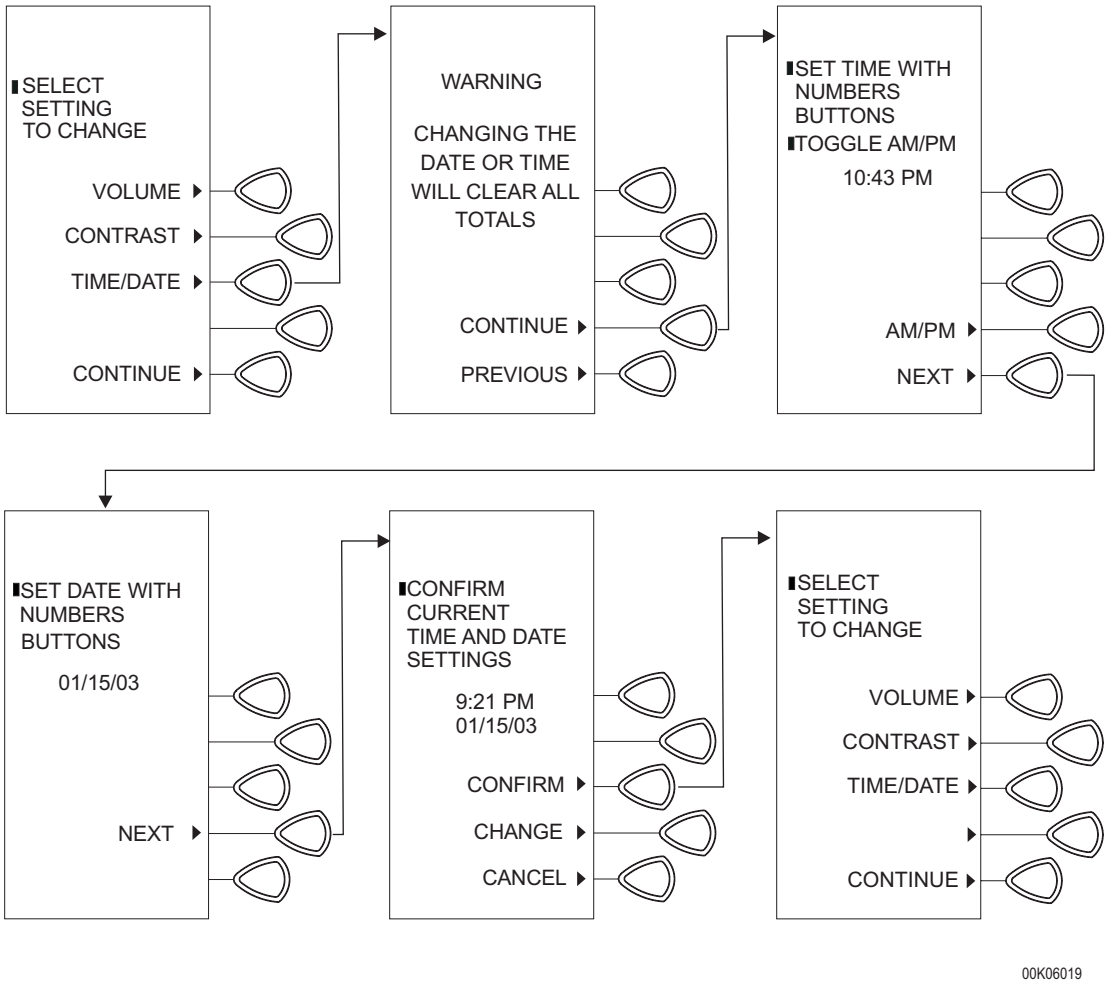

Figure 1-2. Setting the Time and Date

Section 2

WARRANTY

Subject to the terms and conditions herein, Hospira, Inc. herein referred to as Hospira, warrants that (a) the product shall conform to Hospira's standard specifications and be free from defects in material and workmanship under normal use and service for a period of one year after purchase, and (b) the replaceable battery shall be free from defects in material and workmanship under normal use and service for a period of 90 days after purchase. Hospira makes no other warranties, express or implied, as to merchantability, fitness for a particular purpose, or any other matter.

Purchaser's exclusive remedy shall be, at Hospira's option, the repair or replacement of the product. In no event shall Hospira's liability arising out of any cause whatsoever (whether such cause be based in contract, negligence, strict liability, other tort, or otherwise) exceed the price of such product, and in no event shall Hospira be liable for incidental, consequential, or special damages or losses or for lost business, revenues, or profits. Warranty product returned to Hospira must be properly packaged and sent freight prepaid.

The foregoing warranty shall be void in the event the product has been misused, damaged, altered, or used other than in accordance with product manuals so as, in Hospira's judgment, to affect its stability or reliability, or in the event the serial or lot number has been altered, effaced, or removed.

The foregoing warranty shall also be void in the event any person, including the Purchaser, performs or attempts to perform any major repair or other service on the product without having been trained by an authorized representative of Hospira and using Hospira documentation and approved spare parts. For purposes of the preceding sentence, "major repair or other service" means any repair or service other than the replacement of accessory items such as batteries, flow detectors, detachable AC power cords, and patient pendants.

In providing any parts for repair or service of the product, Hospira shall have no responsibility or liability for the actions or inactions of the person performing such repair or service, regardless of whether such person has been trained to perform such repair or service. It is understood and acknowledged that any person other than a Hospira representative performing repair or service is not an authorized agent of Hospira.

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Section 3

SYSTEM OPERATING MANUAL

A copy of the system operating manual is included with every LifeCare PCA 3 infusion system. Insert a copy here for convenient reference. If a copy of the system operating manual is not available, contact Hospira Technical Support Operations *(see Section 6.1, Technical Assistance)*.

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Section 4

THEORY OF OPERATION

This section describes the PCA 3 infusion system theory of operation. Related drawings are provided in *Section 9, Drawings*. The theory of operation details the general description, electronics overview, and mechanism assembly.

4.1 GENERAL DESCRIPTION

The PCA 3 includes the following features:

- ❏ Therapies
  - PCA
  - Continuous
  - PCA + continuous
- ❏ Battery
  - Battery icon
  - 8 V battery pack
- ❏ Biomedical
  - Serial communication
  - Field upgradability
  - Diagnostics setup options
  - Alarm history
- ❏ Options
  - Volumes infused history
- ❏ Other features
  - Microprocessor control
  - Liquid crystal display (LCD) screen
  - Light emitting diode (LED) display
  - Panel back illumination on mains power
  - Security features
  - Prefilled and sterile empty vials
  - Automatic drug identification via barcode reader

✎ **Note:** * denotes active low or negative true logic signal.

4.2 ELECTRONICS OVERVIEW

PCA 3 infusion system electronics include the power supply module; supervision circuitry; battery charger; logic interface; LCD interface; keypad interface; serial port; barcode reader; patient pendant; real-time clock; alarm logic; and memory.

4.2.1 POWER SUPPLY MODULE

The power supply module provides regulated DC power to the pump electronics from the AC mains. AC power is converted to 12 V_{DC} by a switching power supply circuit. There are no adjustments or settings.

4.2.2 INPUT POWER LOGIC

Refer to *Figure 9-7, MCU PWA Schematic, Sheet 1 of 6*. The input power logic contains the following:

- ❏ Input voltage switch-over circuitry
- ❏ Eternal power circuitry
- ❏ Power control logic circuitry

4.2.2.1 INPUT VOLTAGE SWITCH-OVER CIRCUITRY

The operation of the PCA 3 electronics is ordinarily powered by the AC power supply (+12V). If the AC power is absent, the sealed lead acid (SLA) battery (Vbat) powers the logic. If the SLA battery fails, the control logic will now briefly operate from a charge stored in a supercap (Vsc). These three power sources are diode connected to drive the unregulated Vbus rail. The Vbus rail powers an eternal 3.3 volt regulator (V3.3), and the Vbus rail is the input to the main power switch.

4.2.2.2 ETERNAL POWER CIRCUITRY

The eternal 3.3 volt power (V3.3) is a continuous source of power for the data memory, real-time-clock (RTC), and the power control logic (PCL). The V3.3 regulator has a very low (20 µA max) quiescent current to prolong the operation while on portable power. The logic automatically switches Vmem, power for the data memory and RTC, over to the lithium back-up battery (VLiBat) if the normal power from the AC and sealed lead acid battery fails.

The supercap will continue to provide operating power to the PCL, RTC, and data memory for at least 10 minutes after removal of AC and SLA battery power.

4.2.2.3
POWER CONTROL LOGIC CIRCUITRY

The power control logic (PCL) controls the logic power switch. Any of four events initiate power-up: AC Power-On (AC_ON), SWon* (front panel Power-On), VialSw* (vial switch), or InjSw* (injector clamp switch). The switch inputs are normally open circuit and pulled high to V3.3. Any high-to-low transition is latched as a power on event (Start) and EnableV is set. AC_ON is true when AC power is applied and stable for greater than approximately 500 ms. Without input from SWon*, VialSw*, or InjSw*, the displays are blanked and battery charging begins.

Following the switch-on event, the microcontroller asserts Pwrhld (MCU Run). The software initialization has tests of the hardware (and test of the primary watchdog) that will generate a second reset* while Pwrhld is still asserted. This reset* will then clear the Pwrhld bit. The PCL will continue to hold EnableV true until Pwrhld is restored.

Any subsequent actuation of the front panel Power-On key is a request to the MCU to shut down, and Sw_Off is signaled. A normal, controlled shutdown will occur as the microcontroller de-asserts Pwrhld if AC power is off. If AC power is present, the PCA 3 will remain powered until AC power is removed.

4.2.3
VOLTAGE SUPERVISION CIRCUIT

The unregulated switched bus voltage, VMOT, is monitored by Watchdog1, and produces a high priority interrupt (IRQ0*) to the microcontroller in advance of loss of operating power at 5.8 V_{DC} ± 0.2 V_{DC}. The microcontroller has approximately 0.5 ms to prepare for loss of power and reset (orderly shutdown).

The +12V input is AC power, and is monitored by Watchdog2. The input is buffered through the PCL and labeled AC_ON. Upon loss of AC power, the microcontroller will discontinue charging the battery if that is in process. The threshold point occurs at 10 volts ± 0.2 volts.

4.2.4
MICROCONTROLLER SUPERVISION CIRCUIT

It is important to protect the system during power transitions, and the microcontroller must be rebooted after the V_{CC} power supply is applied. The microprocessor supervisory circuit generates a reset pulse during power-up and holds the processor in reset during power-down.

When V3.3sw falls below the reset threshold voltage of 2.9 V (typically), the primary watchdog reset* signal goes active low and holds the microprocessor in reset. When V3.3sw rises above the threshold voltage, the reset* remains active low for a minimum of 140 ms.

The timer function of Watchdog1 monitors the activity of the microprocessor. If the microprocessor does not toggle the Watchdog1 input (wd_strobe) within the timeout period, reset* is forced to active low and the alarm logic will sound the alarm. The time-out interval may be as short as 1.2 seconds. The watchdog service must execute at a period not to exceed one second.

4.2.5
LITHIUM BATTERY BACKUP

A lithium “coin cell” battery provides emergency standby power to the RTC and SRAM if the SLA battery is disabled and AC power is off.

The lithium battery discharge current will be less than 26 µA at approximately 25°C temperature. The voltage developed across a 2 K series limiter resistor will provide the measure of the drain current. The test point is labeled VLi.

4.2.6
BATTERY CHARGER

When a battery is discharged, its terminal voltage will be less than 7.8 volts (1.95 volts per cell) with the charger off. A discharged battery has a depleted electrolyte that is very resistive (non-conductive). When a charge current is first applied, the terminal voltage will rise as a function of the effective IR drop developed in series with the cell voltage. The voltage output of the charger is limited to 9.5 volts to protect the battery from overstress during charging. As the battery begins to accept a charge, the electrolyte becomes more conductive and the terminal voltage drops as the IR drop is less. The cell voltage then rises as it charges. When a cell is fully charged, any additional charge is wasted as disassociation of the water into hydrogen and oxygen. The gas bubbles accumulate on the plates, and the resistance rises. Overcharging is marked by a rapid rise in terminal voltage, as the added IR drop is summed with the fully charged cell voltage.

CAUTION: Continued overcharging will overheat and damage the battery.

A fully charged battery has a terminal voltage greater than 8.6 volts (2.15 volts per cell) with the charger off. If the terminal voltage is less than 9.0 volts but greater than 8.6 volts, the charger can be enabled in the low charge mode until the terminal voltage rises to 9.3 volts, or the charge time has elapsed.

After the battery has been brought to the fully charged condition, the charger is shut off and the trickle charge will take over with a float voltage of 9.2 V (2.3 volts per cell).

Rapid charging at 1.00 A is limited to 202 minutes, or 125% of the 2.7 AHr capacity of the SLA. If the battery reaches 9.3 volts during rapid charge, rapid charging is continued for 25% of the time that it took to reach the 9.3 volt threshold. For example, the charger is enabled and rapid charge is applied for 120 minutes; then rapid charging is continued for an additional 30 minutes.

If rapid charging was successfully achieved, then low charge rate charging is to be continued for 50% of the time needed to rapid charge to the 9.3 volt threshold. As in the previous example, 60 minutes at the low charge rate is needed to finish charging the battery.

4.2.6.1
LOW BATTERY DETECTION

If, during operation on battery (no AC power, charger off), the terminal voltage falls below 7.7 volts (owing to IR drops internal to the battery and fuse, while the cell voltage is actually 7.9 volts) for more than 3 seconds, the battery is low, and the “LOW BATTERY” alarm state is triggered.

4.2.6.2
DISCHARGED BATTERY DETECTION

If, during operation on battery (no AC power, charger off), the terminal voltage falls below 7.2 volts (owing to IR drops internal to the battery and fuse, while the cell voltage is actually 7.8 volts) for more than 3 seconds, the battery is discharged, and the “DEAD BATTERY” alarm state is triggered.

4.2.7
LOGIC INTERFACE

Refer to *Figure 9-7, MCU PWA Schematic (Microprocessor), Sheet 2 of 6*. The logic interface is a bridge of the microcontroller’s bus timing to the timing requirements of the peripheral devices. The processor and its memory operate at full bus speeds, but the LCD display in particular is not able to respond as fast. The logic also supports address decode for the LED interface, hardware control latch, serial address decode and serial data splitter.

4.2.7.1
GLUE LOGIC – LCD I/O

A function of the glue logic is to generate the timing needed by the display when accessed by the processor.

The LCD requires the following signals.

- Data Bus Gating – the direction control and output enabling of the 8-bit data bus transceiver. The LCD data bus is active only when the processor accesses the LCD (to limit EMI).
- Eclk Generation – the LCD uses early Motorola 6800 timing. Address and read/write control is clocked into the LCD. Eclk is at least 450 ns wide, and delayed at least 150 ns after setup of chip selects. Eclk is active only when the processor accesses the LCD.
- Address Decode – CS1 is a positive logic chip select for the lower 64 x 64 display interface. CS2 is the control for the upper half of the LCD.
- Register Select – LCD_A0 selects between data and control register access of each LCD controller. LCD_A0 selects data when high, control or status is accessed when low. LCD_A0 is active only when the processor accesses the LCD.

4.2.7.2
GLUE LOGIC – SERIAL I/O CHANNEL ENABLE

The microcontroller has two serial interfaces: one for the printer and one for the MCU serial UART used for barcode access. A third serial peripheral interface (SPI) is discretely (bit-by-bit) developed by the MCU on its hardware I/O.

The serial interfaces operate independently of each other and the other microcontroller processes. The SPI interface is shared between two devices, so only one may be enabled for each channel at any one time. The SPI interface is the data link to the RTC and the analog-to-digital converter (ADC).

4.2.8
LCD INTERFACE

A 128 x 64 pixel LCD in portrait orientation is the main user display. The LCD module is based on two Hitachi HD61202 (or similar) column drivers. This is a CMOS logic operating from the 5 volt supply. Since basic CMOS is not logically compatible with TTL or 3.3 volt logic, a bridge interface is required between the two. The bridge is made from a buffer/ translator (74LVC573A), and a simple HCT buffer (74HCT244) operating from the 5 volt supply. The glue logic provides address decoding and Eclk generation, as noted earlier.

4.2.8.1
LCD MODULE

Each LCD driver controls 64 x 64 pixels. Since the display is turned sideways for the portrait aspect ratio, the origin or zero address of the data displayed is the lower left corner, and is 8 pixels wide. The least significant bit is found at the left most pixel. The access to the 64 x 64 space is divided into a 6-bit Y-axis pointer, and a 4-bit X-axis segment (each 8 pixels wide) pointer. The Y-axis address pointer auto-increments to the next display location with each write or read to the data display memory. At overflow of the Y-axis pointer, it returns to the bottom of the display. The second HD61202 is accessed to control the upper set of 64 x 64 pixels.

The display start line register (DSLR) can be used to scroll the display left or right. The scrolled display wraps one edge to the other. Normally it is expected that the DSLR is set to zero.

4.2.8.2
LCD CONTRAST

The LCD contrast is set by an analog control voltage that is adjustable between +5 volts and – 4.5 volts. The LCD module generates a negative – 4.5 volt bias for this purpose (V-5). The MCU controls this node (LCD_Adj) by a PWM signal LCD through an inverting low pass amplifier.

4.2.8.3
LCD BACKLIGHT

A yellow LED panel is integral to the LCD module for the backlight of the LCD display. The MCU PWM port line, BACKLT_EN, controls whether the LED panel is on or off. When the BACKLT_EN is active high, the LCD backlight panel is turned on. The LCD backlight is driven by a constant current regulator (SEPIC controller LT1513) operating from the unregulated supply VMOT. The LCD backlight is driven at 250 mA ± 20 mA, when enabled at standard brightness. When boost is enabled, the backlight may draw 600 - 700 mA.

4.2.8.4
BATTERY INDICATOR

A red LED light bar back-illuminates the battery graphic symbol on the front panel. The control of the battery indicator is independent from the numeric digits and AC indicator. The Battery Indicator is controlled by bit D13. The battery indicator draws approximately 10 mA.

4.2.8.5
AC POWER INDICATOR

A green LED light bar back-illuminates the AC power graphic symbol on the front panel. The AC power indicator is active anytime +12V is present, and is not controlled by the MCU. The AC power indicator draws approximately 10 mA.

4.2.9
KEYPAD INTERFACE

A keypad is used for operator control and data entry. A 4 x 6 switch matrix keypad connects to the MCU PWA through two 8 pin flat-flex connectors. The keypad provides a separate hardware power-on and power-off switch with momentary contacts to a common pin. The keypad has ESD shielding. Additional ESD protection is provided by a high speed clamp (SP720) at each input pin. The MCU scans the rows, setting one bit of six outputs low, through an open drain inverter, and reads the column return (with pull-ups).

4.2.10
SERIAL PORT

Refer to *Figure 9-7, MCU PWA Schematic (LCD Interface) Sheet 3 of 6*. The PCA 3 implements an EIA/TIA-574 (IBM AT RS-232) 9 pin serial DTE interface. The rear panel connector is a female shell with male pins. The connector mounting plate includes jackscrews.

The baud rate, word length, start/stop bits, and parity settings are internally generated by the MCU. The settings are set to 9600 baud, 8-bit data, one start bit, one stop bit, and no parity. The driver generates the negative bias required for RS-232 type I/O. The driver is ready to operate 1 millisecond after enabled. The driver has internal protection for ESD. The serial port is only active during printing and service modes.

4.2.11
BARCODE READER

The barcode reader (BCR) communicates with the MCU PWA using RS-232 logic levels and serial protocols. The connection is made by a 6 pin, locking, polarized connector.

The baud rate, word length, start/stop bits, and parity settings are internally generated by the MCU. The settings are 9600 baud, 8-bit data, one start bit, one stop bit, and no parity.

When enabled, a high-side switch delivers 5 volts to the BCR. The reader current is approximately 200 mA. To preserve power, the reader is only enabled for a brief time after detection of vial insertion. The reader asynchronously transmits a string each time a barcode is presented to the reader.

4.2.12
PATIENT PENDANT

The patient pendant is a normally open SPDT switch connected to the infusion pump with a 1/4 inch stereo phone jack. The sleeve contact of the phone jack is at common, the tip contact is the normally open signal PCA*.

The jack is metal threaded and bulkhead mounted on the rear of the PCA 3. A harness connects the jack to the MCU PWA with a 4 pin, locking, polarized connector.

Note: The PCA 3 patient pendant cord is color-coded blue. The PCA 3 patient pendant switch button is color-coded black.

4.2.12.1
PCA INPUT

Activation of the patient pendant switch results in signal PCA* going low as long as the switch is held. The third signal PPP*, is low if the cable is connected and the pendant is not pressed. This provides positive identification of a correct and functioning patient pendant.

4.2.13
DOOR SENSOR

The door sensor is a normally open SPDT switch internal to the door latch mechanism. The normally closed contact is not used. A harness connects the sensor to the MCU PWA with a 4 pin, locking, polarized connector.

Closure and locking of the door trips the switch, with the signal Door* going low as long as the door is closed and locked.

4.2.14
MECHANISM ASSEMBLY

The mechanism assembly drives an inverted syringe from a lead screw and stepper motor drive. Sensors in the mechanism monitor the syringe, drive position, and loading force *(see Figure 4-1, Mechanism Assembly)*.

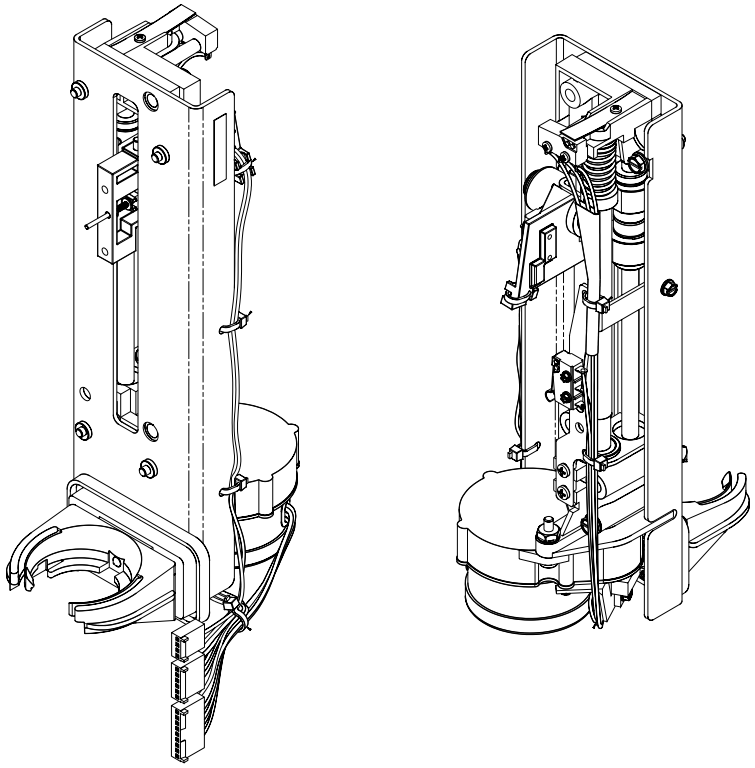

Figure 4-1. Mechanism Assembly

4.2.14.1
VIAL SENSOR

The vial sensor is a normally open SPDT switch behind the cradle that moves as the syringe is emptied. The normally closed contact is not used. A harness connects the sensor to the MCU PWA.

Installation of a drug container into the cradle activates the switch, with the signal VialSw* going low as long as the container is left in place.

4.2.14.2
INJECTOR CLAMP SENSOR

The injector clamp sensor is a normally open SPDT switch behind the clamp at the bottom of the mechanism. The normally closed contact is not used. A harness connects the sensor to the MCU PWA that is common with the syringe empty and pressure occlusion sensors.

Installation of a drug container into the clamp trips the switch, with the signal InjSw* going low as long as the container is left in place.

4.2.14.3
SYRINGE EMPTY SENSOR

The syringe empty sensor is a normally open SPDT switch fixed to sense the travel of the lead screw and cradle mechanism. The normally closed contact is not used.

Passage of the cradle as the container is emptied trips the switch, with the signal SyrngMT* going low as long as the container is nearly empty or the cradle is left at the bottom of its travel.

4.2.14.4
PRESSURE OCCLUSION SENSOR

The pressure occlusion sensor is an SPDT switch fixed to sense the thrust load of the lead screw and cradle mechanism.

A leaf spring holds the switch closed. When approximately 15 psi ± 5 psi force is generated in the mechanism, the leaf is released, trips the switch, with the signal PresLim* going low as long as the pressure is maintained.

4.2.14.5
SHAFT SENSOR

A slotted optical interrupter sensor monitors a mechanical flag coupled to the rotation of the lead screw with a flat extension. Each revolution opens and closes the slotted optical path. The connections to the sensor are combined with the motor.

The sensor is enabled by the active high SNSRTST signal. The sensor output is valid one ms after setting SNSRTST.

The sensor output, PMP_FLG, is high if the sensor's optical path is blocked or if the sensors are not enabled. The LED drive current will be 10 mA.

4.2.14.6
DUAL BIPOLAR DRIVE

The motor drive is a major current drain in the operation of the infusion pump. To conserve power, a bipolar constant current drive is used. This motor has two windings that are electrically 90° out of phase *(see Figure 4-2, Dual Bipolar Drive)*.

A chopper circuit regulates the current in each winding. The coil current magnitude is preset to one of three settings (high, low or off) by the I_SET and MotEN* bits. The motor current polarity is controlled by the signals MotAph and MotBph for sequencing *(see Table 4-1, Motor Step Table)*.

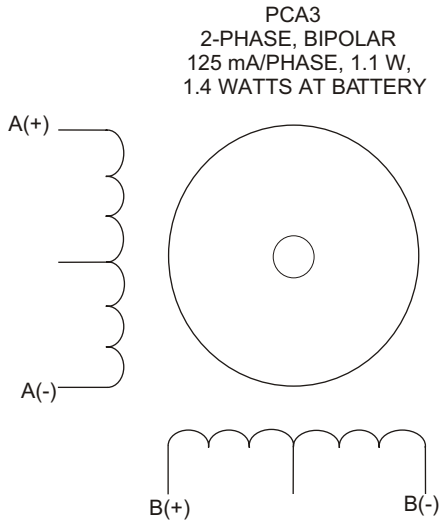

Figure 4-2. Dual Bipolar Drive

Table 4-1. Motor Step Table

MotBph	MotAph	Step Sequence
1	0	1
1	1	2
0	1	3
0	0	4

4.2.15
REAL-TIME CLOCK

Refer to *Figure 9-7, MCU PWA Schematic (I/O), Sheet 4 of 6*. The real-time clock (RTC) is a serial peripheral to the microcontroller that provides calendar, day-of-the-week, hours-minutes-seconds time keeping and extra storage in 31 x 8 RAM. The RTC operates from the eternal logic power or the lithium battery.

4.2.16
ALARM LOGIC

Refer to *Figure 9-7, MCU PWA Schematic (Analog), Sheet 5 of 6*. The MCU PWA controls an audible buzzer that is activated either under software control, during MCU reset period, or under catastrophic failure.

4.2.16.1
NORMAL ALARM

The alarm will sound each time the PCA 3 powers on. The microcontroller inhibits the logic after it wakes up. The default volume at power-on is set to maximum.

4.2.16.2
CRITICAL FAILURE ALARM

During a critical failure, the audible alarm will be continuous. A critical failure is any event that trips the watchdog reset* without first clearing the EnableV bit. The alarm will continue for several seconds while powered from a stored charge (supercap) in the event of failure of the SLA battery.

4.2.16.3
NORMAL SHUTDOWN INHIBIT

The power down sequence is initiated by the microcontroller through the power control logic, which de-asserts EnableV. If EnableV is low when reset* occurs, the alarm is inhibited.

4.2.16.4
VOLUME CONTROL

The alarm volume can be set to low, medium, or high. The difference in volume between settings will be between 10 dB to 20 dB. The low alarm volume is at least 45 dB.

4.2.16.5
ALARM TONE

The alarm tone is a fixed frequency between 2000 and 4000 Hz. The alarm is set at the factory to generate maximum volume.

Note: The alarm volume, if operated with opened enclosure, is greater than 95 dB, and hearing protection maybe required.

4.2.16.6
NORMAL KEY TONE

Activating the alarm for 10 to 50 ms at medium volume will indicate valid keypad input.

4.2.17
PROGRAM MEMORY

The program code is stored in a 256 K x 16 flash ROM. The flash memory is to be erased and rewritten in-circuit. The erasure and reprogramming is accomplished by protected servicing operation.

4.2.18
DATA MEMORY

The data storage is to be a 128 K x 8 SRAM with low standby current drain. The RAM is continuously powered from the eternal supply voltage, Vmem, to provide non-volatility. Critical data is checksummed for security.

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Section 5

MAINTENANCE AND SERVICE TESTS

A complete maintenance program promotes infusion pump longevity and trouble-free instrument operation. Such a program should include routine maintenance, periodic maintenance inspection, and following any repair procedure, performance verification testing.

5.1 ROUTINE MAINTENANCE

Routine maintenance consists of basic inspection and cleaning procedures. As a minimum requirement, inspect and clean the infusion pump after each use. In addition, establish a regular cleaning schedule for the infusion pump.

5.1.1 INSPECTION

Inspect the infusion pump periodically for signs of defects such as worn accessories, broken instrument connections, or damaged cables. In addition, inspect the pump after repair or during cleaning. Replace any damaged or defective external parts. See *Section 5.2.2, Inspection*, for a detailed list of areas to be inspected.

5.1.2 CLEANING

The following procedures are designed to maintain the infusion pump, sustain system longevity, and promote trouble-free instrument operation.

Follow hospital protocol for establishing the cleaning schedule.

WARNING: DISCONNECT THE INFUSION PUMP FROM AC POWER PRIOR TO CLEANING THE INSTRUMENT. FAILURE TO COMPLY WITH THIS WARNING COULD RESULT IN ELECTRICAL SHOCK.

CAUTION: Do not immerse the infusion pump in liquids. Immersion could damage the instrument. Do not allow liquids to enter the infusion pump electronics compartment.

CAUTION: Do not spray cleaning solutions toward any openings in the infusion pump.

CAUTION: Certain cleaning and sanitizing compounds may slowly degrade components made from some plastic materials. Using abrasive cleaners or cleaning solutions not recommended by Hospira may result in product damage and, potentially, void the product warranty. Do not use compounds containing combinations of isopropyl alcohol and dimethyl benzyl ammonium chloride.

CAUTION: Do not use solvents that are harmful to plastic, such as isopropyl alcohol or acetone. Do not use abrasive cleaners.

CAUTION: To avoid infusion pump damage, cleaning solutions should be used only as directed in *Table 5-1, Cleaning Solutions*. The disinfecting properties of cleaning solutions vary; consult the manufacturer for specific information.

1. Clean the exposed surfaces of the infusion pump with a soft, lint-free cloth dampened with one of the cleaning solutions listed in *Table 5-1*, or a mild solution of soapy water.
2. Remove soap residue with clear water.

Table 5-1. Cleaning Solutions

Cleaning Solution	Manufacturer	Preparation
Coverage™ HB	Steris Corporation	Per manufacturer's recommendation
Dispatch™	Caltech Industries	Per manufacturer's recommendation
Manu-Klenz®	Steris Corporation	Per manufacturer's recommendation
Precise™	Caltech Industries	Per manufacturer's recommendation
Sporicidin®	Sporicidin International	Per manufacturer's recommendation
Household bleach	Various	Per hospital procedures; do not exceed one part bleach in ten parts water

5.1.3 SANITIZING

Sanitize the external surfaces of the infusion pump using a cleaning solution listed in *Table 5-1*.

Note: Not all cleaning solutions are sanitizers. Check product labeling.

CAUTION: Do not sterilize the infusion pump using heat, steam, ethylene oxide (ETO), or radiation. These methods may cause the instrument to malfunction.

5.2 PERFORMANCE VERIFICATION TEST

The performance verification test (PVT) consists of the tests described in the following sections. The PVT can be used for diagnostic purposes during the troubleshooting of a malfunctioning infusion pump. Perform the PVT before an infusion pump is placed back in service after repair. If any malfunction is detected as a result of the PVT, contact Hospira.

Note: Perform the PVT exactly as described in this manual to assure effective and reliable product evaluation information.

5.2.1 REQUIRED EQUIPMENT

The PVT requires the following equipment (or equivalents):

- ❏ Door key
- ❏ PCA 3 sterile empty vial and injector (List No. 6021)
- ❏ PCA set (List No. 3559)
- ❏ Graduated cylinder, 25 mL, with 0.2 mL graduations (Type A)
- ❏ Three-way stopcock, latex-free (List No. 3233-01)
- ❏ Digital pressure meter (DPM), 0 to 50 psi (Fluke® Biomedical DPM3)
- ❏ Safety analyzer (Fluke Biomedical 232D)
- ❏ 21-gauge butterfly needle, latex-free (List No. 4492-01), or blunt cannula

5.2.2 INSPECTION

Inspect the infusion pump periodically for signs of defects such as worn accessories or damaged cables. Also, inspect the infusion pump after repair or during cleaning. Replace any damaged or defective external parts.

Inspect the following areas for missing or damaged parts:

- Labels
- AC power cord
- Velcro® retainer straps
- Rubber foot pads
- Door assembly and handle
- Keypad
- External screws
- Pole clamp assembly
- Front and rear enclosures
- Battery access cover
- LCD
- LEDs

5.2.3
TEST SETUP

WARNING: A PATIENT SHOULD NEVER BE CONNECTED TO THE INFUSION PUMP DURING DEVICE TESTING.

To set up the infusion pump for the PVT, proceed as follows:

1. Using the dual-lock mechanism, secure the pump to an IV pole.

   Note: When the security door is locked, the pump locks to the pole clamp and prevents its removal without a key.

2. Plug the AC power cord into a grounded, hospital-grade 120 V_{AC}, 50-60 Hz receptacle.
3. Connect the appropriate Hospira PCA set to a Hospira 30 mL PCA vial/injector.

   CAUTION: Make certain all caps on the vial and the administration set are removed and all clamps are open when priming.

4. Prime the vial and administration set. Hold the vial vertically with the administration set extending from the top. Slowly push down on the injector until all air is cleared from the vial and administration set.

5.2.4
SELF TEST

CAUTION: Do not place the infusion pump in service if self test fails.

To perform the self test, refer to *Figure 5-1, PCA 3 Self Test Screens*, and proceed as follows:

1. Unlock and open the security door.
2. Verify the AC plug indicator on the front panel is illuminated.
3. Press the [ON/OFF] touchswitch to turn the power on. The pump will perform a self test verifying the integrity of the software, memory, and selected electronic functions.

   Note: If there is insufficient battery power for reliable operation, the pump will power itself off as soon as possible, without displaying an alarm message.

   Note: If a battery is not installed, press the [CONTINUE] softkey at the "BATTERY NOT INSTALLED" message.

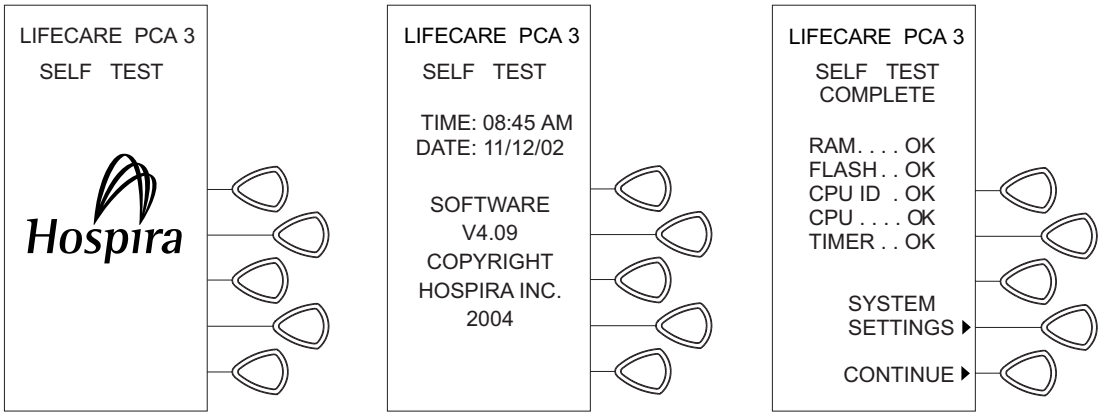
4. Verify "SELF TEST COMPLETE" displays.
5. Verify the time and date. To correct the time and date, refer to *Section 1.7.4, Setting the Time and Date*.

   Note: If the quality of earth grounding source is in doubt, use battery power.

   Note: When the plug indicator is off and the battery indicator is flashing, it is an indication that the PCA 3 is operating on low battery power and should be recharged.

6. Press the [ON/OFF] touchswitch to turn off the pump.

Note: If an alarm condition occurs during the self test, press [ON/OFF] twice. If the alarm condition recurs, note the message and take corrective action *(see Section 6, Troubleshooting)*. Repeat the self test. If the alarm condition recurs, remove the PCA 3 from service and contact Hospira.



00K06001

Figure 5-1. PCA 3 Self Test Screens

5.2.5
SERVICE MODE TESTS

Table 5-2, System Tests provides a list of tests and options available in the service mode. Each test displays prompting information on the LCD screen to serve as a guide through the test. Prompts and descriptions are shown in *Table 5-2*.

Note: The battery and patient pendant must be connected to the infusion pump to complete the service mode test.

Note: Verify that the patient pendant has a label that states: “For use with PCA 3 pumps ONLY!”

To enter the service mode, proceed as follows:

1. Confirm the AC power indicator (AC plug) on the front panel is illuminated.
2. Unlock and open the security door.
3. Press and hold the [ENTER] touchswitch and the [ON/OFF] touchswitch simultaneously.
4. Verify the **Service Mode** screen displays. The **Service Mode** screen includes the current software version and the total elapsed days since new software was downloaded or the pump was initialized in Hospira Mode. Press the [CONTINUE] softkey.
5. Verify the infusion pump is not connected to a patient and press the [CONTINUE] softkey.

6. After the power up RAM test is completed, the infusion pump displays the **Service Mode Main Menu** screen. Press the [MAINTENANCE] softkey.
7. Press the [SYSTEM TEST] softkey.
8. Select the test to be performed by pressing the corresponding softkey *(see Table 5-2)*. Navigate through the service mode tests by using the [NEXT] and [PREVIOUS] softkeys.
9. Once all of the tests are complete, press the [EXIT] softkey to return to the **Service Mode** screen.
10. When all tests are completed, press the [ON/OFF] touchswitch to power off the infusion pump.

Table 5-2. System Tests

Test	Description
RAM	Test is performed to determine the integrity of the address lines used to select specific memory locations for data access. Microcomputer RAM memory is tested
EPROM	Checksum is calculated and compared to a pre-stored and pre-calculated value to assure the operating program residing in EPROM is intact
CPU	Test routine is performed and the test results are verified to assure that the microcomputer is executing instructions properly
CLOCK	Real-time clock is tested to verify its accuracy
LCD	Non-displaying test pattern is written to the LCD RAM and compared with a stored pattern to assure that the LCD screen can accurately display data
BACKLIGHT	Display backlight is turned off and on
LED	Pattern of 1s through 9s is displayed by the LEDs to verify operation
INDICATOR	Test verifies battery and AC symbols are turned on and off when the power cord is connected and disconnected
KEYPAD	Stuck touchswitch test determines if any of the touchswitches are permanently shorted. Press individual touchswitches to determine if the touchswitch operates and the microcomputer recognizes the correct touchswitch. Test patient pendant pushbutton
DOOR	Test verifies the microcomputer recognizes when the security door is locked or unlocked
SYRINGE	Test verifies the microcomputer can detect the presence and proper positioning of the vial and injector in the syringe driver mechanism
EMPTY SYRINGE	Test verifies the microcomputer detects an empty syringe
ALARM	Audible alarm signal is generated to verify the alarm circuitry
ROTATION	Motor is rotated a given amount and the shaft sensor signal is checked by the motor control circuitry
BAR CODE	Test verifies the barcode reader is functioning

5.2.6
DELIVERY ACCURACY TEST

To perform the delivery accuracy test, proceed as follows:

1. Unlock and open the security door.
2. With the cradle in the uppermost position, insert a water-filled, primed PCA 3 vial and PCA 3 set, with a 21-gauge butterfly, into the cradle.
3. Squeeze the cradle release mechanism and move the cradle down until the vial injector snaps into the bottom bracket.
4. Verify the “SELF TEST COMPLETE” message displays. Press the [CONTINUE] softkey.
5. Verify the “CONFIRM CUSTOM VIAL TO RX” message displays. Press the [CONFIRM] softkey.

   Note: If no history is stored, the “HISTORY CLEARED” message displays briefly. Proceed to step 9.

6. Verify the “CLEAR HISTORY” message displays. Press the [YES] softkey.
7. Verify the “CONFIRM CLEAR HISTORY” message displays. Press the [CONFIRM] softkey.
8. The “HISTORY CLEARED” message displays briefly.
9. Verify the “PURGE?” message displays. Press the [YES] softkey.
10. Verify the “PRESS AND HOLD PURGE KEY” message displays. Press and hold the [PURGE] softkey until all air is cleared from the PCA 3 set. Release the [PURGE] softkey.
11. Verify the “PURGE COMPLETE?” message displays. Check for air-in-line and confirm the set is primed. Press the [YES] softkey.
12. The “RECONNECT SET TO PATIENT” message displays briefly.
13. Place the butterfly in a 25 mL graduated cylinder.
14. Verify the “SELECT UNITS OF MEASURE” message displays. Press the [MILLIGRAMS] softkey.
15. Verify the “ENTER DRUG CONCENTRATION” message displays. Using the numeric keypad, press the [1] touchswitch, then press [ENTER].
16. Verify the “CONFIRM 1 mg/mL CONCENTRATION TO PHYSICIAN RX” message displays. Press the [CONFIRM] softkey.
17. Verify the “SET LOADING DOSE” message displays. Press the [YES] softkey.
18. Verify the “ENTER LOADING DOSE” message displays. Using the numeric keypad, enter 10 mg, then press [ENTER].
19. Verify the “PRESS START BUTTON TO INFUSE” message displays. Press the [START/PAUSE] touchswitch.
20. Verify the “PRESS PAUSE BUTTON TO STOP” message displays, and the pump is delivering fluid.

    Note: When the loading dose is complete the “CHECK SETTINGS” alarm sounds and the pump displays the “COMPLETE OR CORRECT PUMP SETTING” message. Press [SILENCE/VOLUME] to clear.

21. Verify the “SELECT DELIVERY MODE” message displays when the loading dose is completed. Press the [PREVIOUS] softkey.
22. Verify the “SET LOADING DOSE?” message displays. Press the [YES] softkey.
23. Repeat Steps 18 through 20.

24. Once the second loading dose is completed, verify the infusion pump delivered 20mL ± 1 mL.
25. Remove the blunt cannula or needle from the distal end of the PCA 3 set.
26. Press the [ON/OFF] touchswitch to power off the pump.

5.2.7
OCCLUSION TEST

To perform the occlusion test, proceed as follows:

1. Unlock and open the security door.
2. With the cradle in the uppermost position, insert a water-filled PCA 3 vial with a primed PCA 3 administration set into the cradle assembly.
3. Squeeze the cradle release mechanism and move the cradle down until the vial injector snaps into the bottom bracket.
4. Connect the distal end of the PCA 3 set to the DPM through a three-way stopcock. Set the three-way stopcock to air.
5. Verify the “SELF TEST COMPLETE” message displays. Press the [CONTINUE] softkey.
6. Verify the “CONFIRM CUSTOM VIAL TO RX” message displays. Press the [CONFIRM] softkey.
7. Verify the “CLEAR HISTORY?” message displays. Press the [YES] softkey.
8. Verify the “CONFIRM CLEAR HISTORY” message displays. Press the [CONFIRM] softkey.
9. “HISTORY CLEARED” displays briefly
10. Verify the “PURGE?” message displays. Press the [YES] softkey.
11. Verify the “PRESS AND HOLD PURGE KEY” message displays. Press and hold the [PURGE] softkey until flow is seen through the PCA 3 set. Release the [PURGE] softkey.
12. Verify the “PURGE COMPLETE?” message displays. Check for air-in-line and assure the set is primed. Press the [YES] softkey.
13. The “RECONNECT SET TO PATIENT” message displays briefly.
14. Verify the “SELECT UNITS OF MEASURE” message displays. Press the [MILLIGRAMS] softkey.
15. Verify the “ENTER DRUG CONCENTRATION” message displays. Using the numeric keypad, press the [1] touchswitch, then press [ENTER].
16. Verify the “CONFIRM 1 mg/mL CONCENTRATION TO PHYSICIAN RX” displays. Press the [CONFIRM] softkey.
17. Verify the “SET LOADING DOSE” message displays. Press the [YES] softkey.
18. Verify the “ENTER LOADING DOSE” message displays. Press the [1] touchswitch, then the [0] touchswitch, then press [ENTER].
19. Verify the DPM reads zero.
20. Verify the “PRESS START BUTTON TO INFUSE” message displays. Press the [START/PAUSE] touchswitch.
21. Verify the “PRESS PAUSE BUTTON TO STOP” message displays.
22. Verify fluid discharge at the end of the stopcock, then close the stopcock.
23. Verify the infusion pump sounds an alarm and displays “OCCLUSION”. Verify the “CHECK PCA 3 SET TO RELIEVE PRESSURE” message appears.
24. Press the [SILENCE] touchswitch and verify the DPM reads 15 ± 5 psi.

25. Open the stopcock to clear the occlusion alarm.
26. Remove the vial from the infusion pump.
27. Press the [ON/OFF] touchswitch to power off the pump.

5.2.8 ELECTRICAL SAFETY TEST

To perform the electrical safety test, proceed as follows:

1. Connect the AC power cord to an approved safety analyzer. Leakage current must not exceed 50 µA, but must be greater than 2 µA (open ground).
2. Using the safety analyzer, measure the resistance between the ground lug of the AC connector and exposed metal parts, such as the door key lock, patient pendant connector, or the exposed screw heads on the pole clamp. Resistance should not exceed 0.1 Ω.

Note: The door hinge is not grounded.

Note: Exposed metal on the infusion pump is isolated from ground.

5.2.9 END OF THE PVT

If all tests have been successful, proceed as follows:

1. Clear device history.
2. Reset the PCA 3 infusion system to the original configuration.
3. Verify the correct time and date.
4. Return the PCA 3 infusion system to service.

Note: If any tests fail, refer to *Section 6, Troubleshooting*, or contact Hospira.

5.3
PRINTER TEST (OPTIONAL)

To perform the printer test, proceed as follows:

1. Connect a serial printer cable to the printer port on the infusion pump.
2. Power on the printer. Press the printer [ON-LINE] switch and verify the on-line LED lights.
3. Confirm the AC power indicator (AC plug) on the front panel is illuminated.
4. Unlock and open the security door.
5. Press and hold the [ENTER] touchswitch and the [ON/OFF] touchswitch simultaneously.
6. Verify the **Service Mode** screen displays. The **Service Mode** screen includes the current software version and the total elapsed days since the infusion pump was placed in service. Press the [CONTINUE] softkey.
7. Verify the infusion pump is not connected to a patient and press the [CONTINUE] softkey.
8. After the power up RAM test is completed, the infusion pump displays the **Service Mode Main Menu** screen. Press the [DIAGNOSTIC] softkey.
9. Verify “SELECT ONE” is displayed. Press the [PRT EVENT LOG] softkey.
10. Verify printing occurs.

Note: When performing this test after replacing the MCU PWA, an error message may appear. To clear the error message, power off the pump and restart.

5.4
PERIODIC MAINTENANCE INSPECTION

Periodic maintenance inspections should be performed per hospital procedures for compliance to accreditation requirements. It is recommended that JCAHO and/or hospital protocol be followed for establishing an infusion pump periodic maintenance inspection schedule. Product specifications for this inspection are listed in *Section 8, Specifications*. To perform the periodic maintenance inspection, complete the performance verification test in *Section 5.2*.

5.5
BATTERY OPERATION OVERVIEW

The infusion pump is intended to operate on battery power on an exception basis only, such as emergency backup or temporary portable operation. Examples of emergency backup include AC power failure or inadvertent disconnection of the AC power cord. An instance of temporary portable operation includes patient transfer from one location to another.

The infusion pump should be connected to AC power whenever possible to allow the battery to remain fully charged. The infusion pump line power indicator turns off and the BATTERY legend illuminates when the infusion pump is operating on battery power. When running on battery the backlight extinguishes thirty seconds after the security door is closed and locked. Factors that most commonly affect battery life are the depth and frequency of discharge and the length of the recharge period. As a general rule, the more often the battery is discharged and recharged, the sooner it will need replacement. The primary cause of damage is leaving the battery in a less than fully charged state for any period of time. Battery damage can occur in a matter of hours and cause a permanent loss of battery capacity. The amount of lost capacity depends on the degree of discharge, the storage temperature, and the length of time the battery was stored in a discharged state.

Note: A permanently damaged battery cannot be recharged to full capacity.

When the battery discharges below the acceptable level while the infusion pump is operating, the alarm sounds and the battery icon will flash. Although it is not recommended to continue operating the infusion pump on battery power at this point, the battery continues providing power until discharged. At this point, the infusion pump enters the battery discharged mode, a continuous audible alarm sounds for three minutes, followed by the infusion pump powering itself off.

CAUTION: As soon as the LOW BATTERY alarm occurs, connect the infusion pump to AC power.

Recharging occurs any time the infusion pump is connected to AC power. It is recommended that the infusion pump be connected to AC power whenever practical to maximize available battery charge during transport or ambulation. The infusion pump does not have to be on for the battery to recharge. Recharging while the infusion pump is operating is program dependent.

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Section 6

TROUBLESHOOTING

This section contains information on technical assistance, diagnostic mode, alarm messages and error codes, and troubleshooting procedures for the LifeCare PCA 3.

6.1 TECHNICAL ASSISTANCE

For technical assistance, product return authorization, and to order parts, accessories, or manuals within the United States, contact Hospira Technical Support Operations.

1-800-241-4002

For additional technical assistance, including Technical Service Bulletins, technical training, and product information, visit the website at:

www.hospira.com

Send all authorized, prepaid returns within the United States to the following address:

Hospira, Inc.
Technical Support Operations
755 Jarvis Drive
Morgan Hill, California 95037

For technical assistance, product return authorization, and to order parts, accessories, or manuals from outside the United States, contact the nearest Hospira sales office.

6.2 DIAGNOSTIC MODE

The diagnostic mode provides the following features:

- ❏ Printout of the event log
- ❏ Printout of malfunctions (50 max.)
- ❏ Clearing of diagnostic information

WARNING: A PATIENT SHOULD NEVER BE CONNECTED TO THE INFUSION PUMP DURING DIAGNOSTIC MODE OR SERVICE MODE.

To enter the diagnostic mode, refer to the *PCA 3 System Configuration Guide* and proceed as follows:

1. Confirm the AC power indicator (AC plug) on the front panel is illuminated.
2. Unlock and open the security door.
3. Press and hold [ENTER] and [ON/OFF] simultaneously.
4. Verify the **SERVICE MODE** screen is displayed. The **SERVICE MODE** screen includes the current software version and the total elapsed days since new software was downloaded or the pump was initialized. Press the [CONTINUE] softkey.
5. Connect the pump to a printer, and press [CONTINUE].
6. After the power up RAM test is completed, the infusion pump displays the **SERVICE MODE** main menu screen.
7. Press the [DIAGNOSTICS] softkey and verify the Diagnostics menu appears.
8. Press the [PRT EVENT LOG] softkey to print the event log.
9. Press the [PRT MALF. LOG] softkey to print the malfunction log.
10. Press the [INIT. PUMP] softkey to initialize the pump, then press [CONTINUE].

    Note: Initializing the pump will clear all data, including stored protocols, and return the pump to its default settings.

11. Press [YES]. After initializing, the pump returns to the **DIAGNOSTICS** screen.
12. Press [EXIT] to return to the **SERVICE MODE** screen, or power off, then on, to exit the service mode and return the pump to normal operation.

6.3 ALARM MESSAGES AND ERROR CODES

Under most alarm conditions, the infusion pump ceases normal operation, generates an audible alarm, and displays an alarm message or error code on the LCD screen.

There are two types of alarm conditions:

- alarm codes that can be cleared by the operator
- error codes that require qualified service personnel

Refer to *Table 6-1, Operational Alarm Messages*, and *Table 6-2, Error Codes Requiring Technical Service*.

6.3.1 OPERATIONAL ALARM MESSAGES

Table 6-1 lists infusion pump alarm messages that can be cleared by the operator. Also listed in *Table 6-1* are the possible causes and corrective actions.

Note: Operational alarm messages are displayed on the LCD screen. Associated error codes are displayed in the alarm history.

Table 6-1. Operational Alarm Messages

Alarm Message	Possible Cause	Corrective Action
Check Settings	Door secured on any screen other than the Press Start to Begin or Setup/ Change Menu screen or No key pressed for two minutes	Open the door, check therapy settings, finish programming therapy settings
Occlusion	Occlusion detected	In setup mode: release and back off cradle assembly In patient mode: open the door, release and back off cradle assembly
Check Syringe	Syringe (vial and injector) is not properly loaded	Properly insert syringe into cradle assembly
Check Vial	Injector is detected and vial is not properly loaded	Properly insert vial into cradle assembly or remove injector
Check Injector	The vial is detected and the injector is not detected	Properly insert injector into cradle assembly or vial injector
Empty Syringe	Empty vial is detected	In setup mode: release and back off cradle assembly In patient mode: open the door, release and back off cradle assembly

Table 6-1. Operational Alarm Messages		
Alarm Message	**Possible Cause**	**Corrective Action**
Door Open	Door left open or unlocked for more than two minutes	Close and lock the door
Infuser Paused	Infusion stopped by pressing [START/PAUSE]	Press [START/PAUSE] again, or unlock door
Low Battery	Operating on battery power with less than 30 minutes of battery life	Connect infusion pump to AC power Replace battery *(see Section 7.3.6)* Replace MCU PWA *(see Section 7.3.8.10.5)*
Battery Fault	OB = Open battery OV = Over-discharged battery SH = Shorted battery	Connect infusion pump to AC power Replace battery *(see Section 7.3.6)* Replace MCU PWA *(see Section 7.3.8.10.5)*
Charger Fault	Battery charger is faulty	Connect infusion pump to AC power Replace battery *(see Section 7.3.6)* Replace MCU PWA *(see Section 7.3.8.10.5)*

6.3.2
ERROR CODES REQUIRING TECHNICAL SERVICE

Table 6-2 lists infusion pump error codes that require technical service. Also listed in *Table 6-2* are malfunction descriptions, possible causes, and corrective actions.

Table 6-2. Error Codes Requiring Technical Service			
Alarm Code	**Malfunction Description**	**Possible Cause**	**Corrective Action**
170	Interrupt Overlap	Interrupt failure	Replace MCU PWA *(see Section 7.3.8.10.5)*
171	Invalid Interrupt	Invalid or unused interrupt	
172	Stack Error	RAM error	
173	Task Dead Error	Periodic task or interrupt stopped running	
174	Kernel Error	Kernel failure	

Table 6-2. Error Codes Requiring Technical Service

Alarm Code	Malfunction Description	Possible Cause	Corrective Action
175	Watchdog Error	MCU fails to strobe the watchdog within its timeout period	Verify jumper on pins 5 - 6 of JP1 on MCU PWA Replace MCU PWA *(see Section 7.3.8.10.5)*
176	Cancel Timer Error	Timer message has been unsuccessfully cancelled	Replace MCU PWA *(see Section 7.3.8.10.5)*
200	Motor Overdelivery Condition	Motor is running faster than expected	
201	Motor Underdelivery Condition	Motor is running slower than expected	
202	Motor Runaway	Motor is running without permission	
203	Excessive Rate Rate/Mode Mismatches	Rate is greater than the maximum rate	
204	Mode	Unexpected mode	
205	Motor Step Time Error	Motor step time out of range	
206	Rate	Unexpected rate	
207	Delivery Volume Error	Volume infused is out of range	Contact Hospira
310	5-Volt Error	Two readings outside the range of 4.7 V - 5.3 V	Replace power supply PWA *(see Section 7.3.9.4)*
311	Lithium Battery Error	Lithium battery voltage below acceptable minimum value	Verify lithium battery connection Replace lithium battery *(see Section 7.3.8.10.6)*
313	Battery Current Error	Battery charge current exceeded limit	Verify battery connections Replace battery *(see Section 7.3.6)*

Table 6-2. Error Codes Requiring Technical Service

Alarm Code	Malfunction Description	Possible Cause	Corrective Action
480	Configuration Data	Failed CRC of pump configuration data	For each malfunction press [CLEAR], then [ON/OFF] to power off the pump, then [ON/OFF] to power on the pump; continue until all malfunctions are cleared Verify lithium battery connections Verify pump is connected to AC (mains) power Replace lithium battery *(see Section 7.3.8.10.6)* Replace battery *(see Section 7.3.6)* If malfunction cannot be cleared, contact Hospira
481	Infusion Data	Failed CRC of infusion data	
482	Program Data	Failed CRC of program data	
484	Stored Protocol Data	Failed CRC of stored protocols	
483	Flash Checksum Error	Failed checksum at startup or during operation	Replace MCU PWA *(see Section 7.3.8.10.5)*
485	Motor State	Invalid rate or restart. Bad states or events in motor software	
486	History Corruption	History data corrupted	
487	Motor Data Error	Failed CRC of motor data	
488	Drug Table Data Error	Failed CRC of drug table data	
489	User Interface Data Error	Failed CRC of saved user interface data	Press [ON/OFF] to power off the pump, then [ON/OFF] to power on the pump. If malfunction does not clear, Replace MCU PWA *(see Section 7.3.8.10.5)*
490	Error Log Data Error	Failed error log checksum	Replace MCU PWA *(see Section 7.3.8.10.5)*
491	Background Data Error	Inconsistent background data	
492	Switch Data Error	Corrupted switch data	

Table 6-2. Error Codes Requiring Technical Service

Alarm Code	Malfunction Description	Possible Cause	Corrective Action
493	Mirror Data Mismatched	Data in RAM does not match data in FLASH	Replace lithium battery *(see Section 7.3.8.10.6)* Replace MCU PWA *(see Section 7.3.8.10.5)*
494	UI State Error	User interface state ID out of range	Replace MCU PWA *(see Section 7.3.8.10.5)*
495	Backlight Data Error	Invalid display data	Replace LCD assembly *(see Section 7.3.8.10.2)* Replace MCU PWA *(see Section 7.3.8.10.5)*
496	Vial Manager Data Error	Failed CRC of vial manager data	Replace MCU PWA *(see Section 7.3.8.10.5)*
497	Power Data Error	Failed CRC of battery charging data	
498	Display Data Error	Invalid display data	Replace LCD assembly *(see Section 7.3.8.10.2)* Replace MCU PWA *(see Section 7.3.8.10.5)*
499	Alarm Data Error	Invalid alarm data	Replace MCU PWA *(see Section 7.3.8.10.5)*
550	Power Down Error	Improper shutdown	
551	Intertask Message Error	Illegal intertask message	
552	Invalid Function Parameter	Invalid parameter data	
553	Invalid Message	Invalid kernel message	
554	Invalid Mode	Invalid user interface mode	
555	Clock Change Error	Invalid date	
556	Invalid UI State Action	Invalid user interface action code	
557	Invalid Alarm	Illegal alarm message data	
558	Mode Change Error	Illegal mode change message	
559	Invalid UI Stack	User interface stack is corrupted or full	
620	RAM Address Error	Address lines are stuck high, stuck low, or shorted together	
621	Chip ID Error	Register does not contain expected value	

Table 6-2. Error Codes Requiring Technical Service

Alarm Code	Malfunction Description	Possible Cause	Corrective Action
622	Clock RAM Error	Data or address communication errors	Replace MCU PWA *(see Section 7.3.8.10.5)*
623	External RAM Error	Failed read/write operations on external RAM	
624	LCD Backlight	Backlight current out of range	Verify LCD assembly connections to MCU PWA Replace LCD assembly *(see Section 7.3.8.10.2)* Replace MCU PWA *(see Section 7.3.8.10.5)*
625	Battery Icon LED	Battery icon LED current out of range	Verify icon PWA connections to MCU PWA Replace icon PWA *(see Section 7.3.8.10.4)* Replace MCU PWA *(see Section 7.3.8.10.5)*
626	Audible Alarm	On or off voltage out of range	Replace MCU PWA *(see Section 7.3.8.10.5)*
627	LCD Readback Error	Display data does not match RAM data	Replace LCD assembly *(see Section 7.3.8.10.2)* Replace MCU PWA *(see Section 7.3.8.10.5)*
628	LED Numeric Display Error	One or more digit segment current is out of range	Verify numeric display PWA connections to MCU PWA Replace numeric display PWA *(see Section 7.3.8.10.3)* Replace MCU PWA *(see Section 7.3.8.10.5)*
629	Clock Time Error	RTC and MCU out of synchronization	Replace MCU PWA *(see Section 7.3.8.10.5)*
630	Screw Rotation Error	Motor steps and screw rotations are not in proportion	Lubricate lead screw *(Section 7.2.6)* Replace mechanism assembly *(see Section 7.3.8.12)* Replace MCU PWA *(see Section 7.3.8.10.5)*

Table 6-2. Error Codes Requiring Technical Service

Alarm Code	Malfunction Description	Possible Cause	Corrective Action
631	LCD Timeout Error	LCD does not acknowledge data within hardware specific-time	Verify LCD assembly connections to MCU PWA Replace LCD assembly *(see Section 7.3.8.10.2)* Replace MCU PWA *(see Section 7.3.8.10.5)*
633	Print Error	Failed UART loopback test	Verify printer operation Replace serial port cable assembly *(see Section 7.3.9.8)* Replace MCU PWA *(see Section 7.3.8.10.5)*
634	ADC Voltage Reference Error	Analog level is out of range	Replace MCU PWA *(see Section 7.3.8.10.5)*
635	Stuck Key	Key stuck for more than two minutes	Replace keypad *(see Section 7.3.8.2)* Replace MCU PWA *(see Section 7.3.8.10.5)*
636	Motor winding excessive current	Motor winding current above 200 mA	Replace mechanism assembly *(see Section 7.3.8.12)* Replace MCU PWA *(see Section 7.3.8.10.5)*
637	Motor winding open circuit	Motor winding current below 75 mA	
638	Motor Voltage Error	Motor voltage is out of range	
639	Contrast Voltage Error	Contrast voltage is out of range	Verify LCD assembly connections to MCU PWA Replace LCD assembly *(see Section 7.3.8.10.2)* Replace MCU PWA *(see Section 7.3.8.10.5)*
640	Internal RAM Error	Failed read/write operations on internal RAM	Replace MCU PWA *(see Section 7.3.8.10.5)*
641	Occlusion Switch Error	Defective occlusion sensor	Adjust occlusion alarm switch *(see Section 7.2.5.2)* Replace mechanism assembly *(see Section 7.3.8.12)* Replace MCU PWA *(see Section 7.3.8.10.5)*

Table 6-2. Error Codes Requiring Technical Service			
Alarm Code	**Malfunction Description**	**Possible Cause**	**Corrective Action**
642	Empty Syringe Switch Error	Defective empty syringe sensor	Replace mechanism assembly *(see Section 7.3.8.12)* Replace MCU PWA *(see Section 7.3.8.10.5)*
643	Injector Switch Error	Defective injector sensor	Adjust injector switch *(see Section 7.2.3)* Replace mechanism assembly *(see Section 7.3.8.12)* Replace MCU PWA *(see Section 7.3.8.10.5)*
644	Watchdog Timer Error	Watchdog failure	Verify jumper on pins 5 - 6 of JP1 on MCU PWA Replace MCU PWA *(see Section 7.3.8.10.5)*
645	Barcode Reader Error	Three consecutive attempts to read the barcode have failed	Replace barcode reader *(see Section 7.3.8.13)* Replace MCU PWA *(see Section 7.3.8.10.5)*

6.4
TROUBLESHOOTING PROCEDURES

This section details recommended procedures for problems not associated with malfunction alarms. Before performing any troubleshooting procedure, turn the infusion pump off, then on. Allow the self test to complete and proceed as follows:

1. If a malfunction exists, carefully inspect the infusion pump for damage as described in *Section 5.2.2*.
2. If an infusion pump inspection has not disclosed a malfunction, perform the PVT in *Section 5.2*. Refer to *Table 6-3, Troubleshooting with the PVT*, for PVT section reference, probable cause, and corrective actions.

If, after completing Steps 1 and 2, a malfunction has not been located, or if the infusion pump persistently fails, contact Hospira Technical Support Operations.

Table 6-3. Troubleshooting with the PVT

Test Failure	Probable Cause	Corrective Action
Self Test *(Section 5.2.4)*		Power off infusion pump, then power on If error recurs, contact Hospira
Service Mode Tests *(Section 5.2.5)* *(see Table 5-2)*	Defective MCU PWA	Replace MCU PWA *(Section 7.3.8.10.5)*
IN RAM	Defective MCU PWA	
RAM	Defective MCU RAM	
ROM	Defective EPROM	
CPU	Defective CPU	
CLOCK	Defective RTC	
LCD	Defective LCD assembly	Verify LCD assembly connection to MCU PWA Replace LCD assembly *(Section 7.3.8.10.2)*
	Defective MCU PWA	Replace MCU PWA *(Section 7.3.8.10.5)*
BACKLIGHT	Defective LCD assembly	Verify LCD assembly connection to MCU PWA Replace LCD assembly *(Section 7.3.8.10.2)*
	Defective MCU PWA	Replace MCU PWA *(Section 7.3.8.10.5)*
LED	Defective numeric display PWA	Verify numeric display PWA connection to MCU PWA Replace numeric display PWA *(Section 7.3.8.10.3)*
	Defective MCU PWA	Replace MCU PWA *(Section 7.3.8.10.5)*
INDICATOR	Defective icon display PWA	Verify icon display connection to MCU PWA Replace icon display PWA *(Section 7.3.8.10.4)*
	Defective MCU PWA	Replace MCU PWA *(Section 7.3.8.10.5)*
KEYPAD	Defective keypad	Replace keypad *(Section 7.3.8.2)*
	Defective MCU PWA	Replace MCU PWA *(Section 7.3.8.10.5)*

Table 6-3. Troubleshooting with the PVT

Test Failure	Probable Cause	Corrective Action
DOOR	Defective door lock assembly	Replace door lock assembly *(Section 7.3.8.7)*
	Defective MCU PWA	Replace MCU PWA *(Section 7.3.8.10.5)*
SYRINGE	Defective mechanism assembly	Adjust vial sensor switch *(Section 7.2.4)* Replace mechanism assembly *(Section 7.3.8.12)*
	Defective MCU PWA	Replace MCU PWA *(Section 7.3.8.10.5)*
EMPTY VIAL	Defective mechanism assembly	Adjust vial sensor switch *(Section 7.2.4)* Replace mechanism assembly *(Section 7.3.8.12)*
	Defective MCU PWA	Replace MCU PWA *(Section 7.3.8.10.5)*
ALARM	Defective MCU PWA	Replace MCU PWA *(Section 7.3.8.10.5)*
ROTATION	Defective mechanism assembly	Replace mechanism assembly *(Section 7.3.8.12)*
PATIENT PENDANT ASSEMBLY	Defective patient pendant assembly	Replace patient pendant assembly *(Section 7.3.7)* Verify that replacement patient pendant is color-coded blue
Delivery Accuracy Test *(Section 5.2.6)*	PCA 3 set not properly primed	Re-prime set and check clamps
	Defective mechanism assembly	Replace mechanism assembly *(Section 7.3.8.12)*
Occlusion Test *(Section 5.2.7)*	Set not properly primed or installed	Prime set
	Defective mechanism	Adjust occlusion alarm switch *(Section 7.2.5)* Replace mechanism assembly *(Section 7.3.8.12)*
Electrical Safety Test *(Section 5.2.8)*	Defective AC power cord	Replace AC power cord *(Section 7.3.5)*

Section 7

REPLACEABLE PARTS AND REPAIRS

This section itemizes all parts and subassemblies of the LifeCare PCA 3 infusion pump that are repairable within the scope of this manual. In addition, this section details replacement procedures for all listed parts.

WARNING: POSSIBLE EXPLOSION HAZARD EXISTS IF THE INFUSION PUMP IS SERVICED IN THE PRESENCE OF FLAMMABLE ANESTHETICS.

WARNING: UNLESS OTHERWISE INDICATED, DISCONNECT THE INFUSION PUMP FROM AC POWER BEFORE PERFORMING ADJUSTMENT OR REPLACEMENT PROCEDURES.

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store PWAs in antistatic bags before placing them on any surface.

7.1 REPLACEABLE PARTS

Replaceable parts for the LifeCare PCA 3 are itemized in the spare parts price list and are identified in *Figure 9-1, Illustrated Parts Breakdown*. *Table 9-2, IPB for the Infusion Pump* identifies each part by an index number that correlates to *Figure 9-1*.

To request a copy of the current spare parts price list, contact Hospira Technical Support Operations *(see Section 6.1)*, or to view the catalog online, visit the website at:

www.hospiraparts.com

For convenient reference, insert a copy of the spare parts price list here.

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7.2 ADJUSTMENT PROCEDURES

WARNING: UNLESS OTHERWISE INDICATED, DISCONNECT THE INFUSION PUMP FROM AC POWER BEFORE PERFORMING ADJUSTMENT OR REPLACEMENT PROCEDURES.

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store PWAs in antistatic bags before placing them on any surface.

Unless otherwise indicated, the following procedures require an empty syringe to be installed in the cradle.

7.2.1 REQUIRED TOOLS AND MATERIALS

The following tools and materials, or equivalents, are required for the adjustment procedures in this section. In addition, the beginning of each procedure lists tools and materials recommended for that specific procedure.

- ❏ Set of standard and metric nutdrivers
- ❏ Set of Phillips® screwdrivers
- ❏ X-acto® knife
- ❏ Needle-nose pliers
- ❏ Diagonal cutters
- ❏ Digital pressure meter (Fluke® Biomedical DPM3)
- ❏ Red GLPT insulating varnish
- ❏ Water-filled syringe
- ❏ PCA 3 vial
- ❏ Three-way stopcock
- ❏ PCA 3 IV administration set (List No. 3559-04)
- ❏ Grease (Braycote® 804)
- ❏ Isopropyl alcohol
- ❏ Lint-free cloth
- ❏ Cotton swabs
- ❏ Small brush

7.2.2
SEPARATING THE FRONT AND REAR ENCLOSURE ASSEMBLIES

The front and rear enclosure assemblies must be separated before performing any adjustment procedure.

The recommended tool for this procedure is a No. 2 Phillips screwdriver.

To separate the front and rear enclosure assemblies, refer to *Figure 7-1, Separating the Front and Rear Enclosure Assemblies*, and *Figure 7-6, Battery Assembly, AC Power Cord, and Patient Pendant Assembly*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Place the pump face down on a soft surface with the security door open approximately 270 degrees.
3. Using the Phillips screwdriver, remove the 6-32 screw that attaches the battery door to the rear of the pump *(see Figure 7-6)*.
4. Remove the battery door.
5. Disconnect the AC power cord by grasping the plug. Do not pull on the power cord.
6. Separate the battery connector assembly from the battery and remove the battery.
7. Using the Phillips screwdriver, remove the 6-32 screws from each corner of the rear enclosure assembly.
8. Raise the rear enclosure approximately 40 degrees.
9. Disconnect connectors P4, P9, P14, and P17 from the MCU PWA.
10. Remove the rear enclosure assembly.

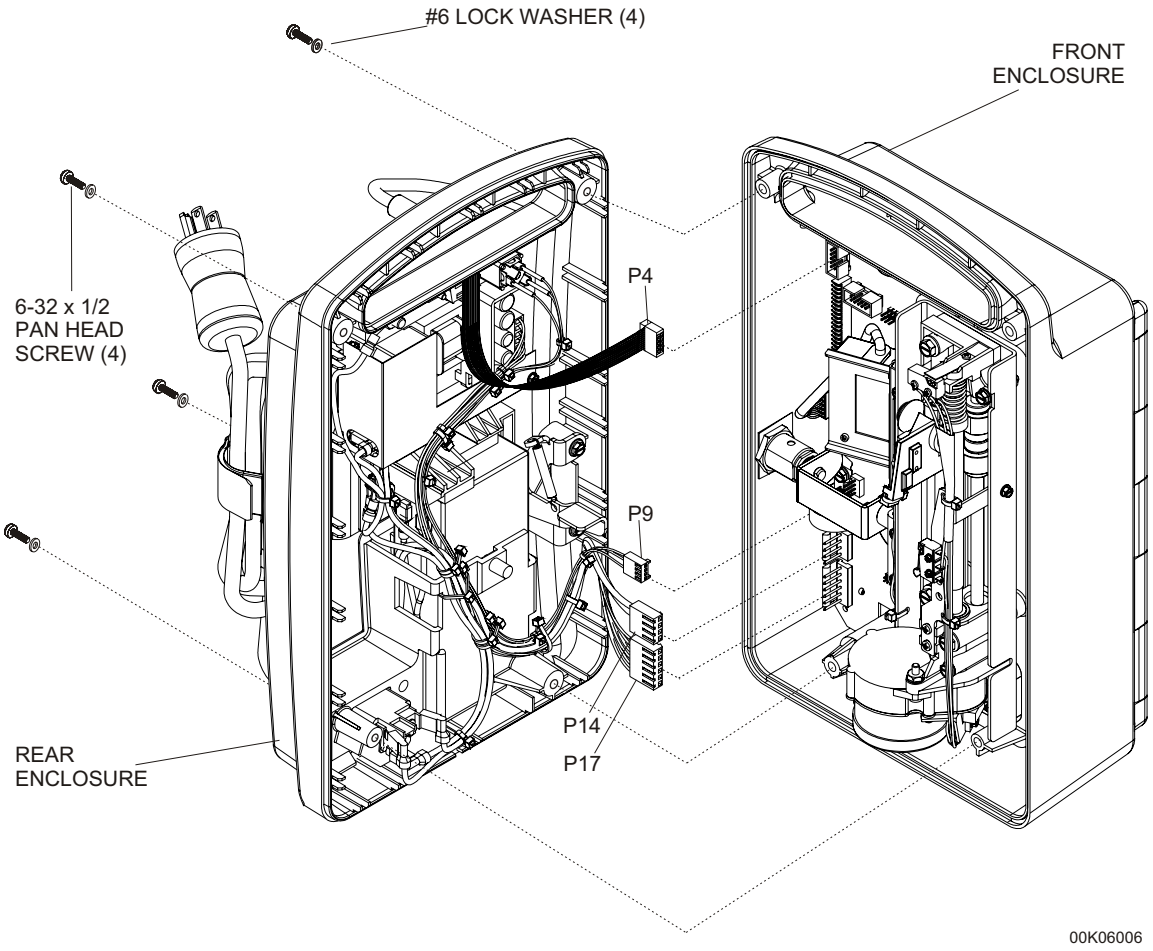

Figure 7-1. Separating the Front and Rear Enclosure Assemblies

7.2.3
INJECTOR SENSOR SWITCH ADJUSTMENT

The recommended tools and materials for this procedure are a 3/16 inch nutdriver and red GLPT insulating varnish.

To adjust the injector sensor switch, refer to *Figure 7-2, Injector Sensor Switch*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Using the nutdriver, loosen the two switch mounting screws until the switch holder can be easily moved. Do not loosen the screws so much that the switch bracket rocks from side to side.
4. Position the switch bracket parallel to the surface and 1/32 inch from the front enclosure. Tighten the screws.
5. Apply red GLPT insulating varnish to the screw heads.
6. Reassemble the infusion pump in the exact reverse order of disassembly.
7. Close and lock the security door.
8. Connect the infusion pump to AC power.

To verify successful adjustment of the injector sensor switch, perform the PVT in *Section 5.2*.

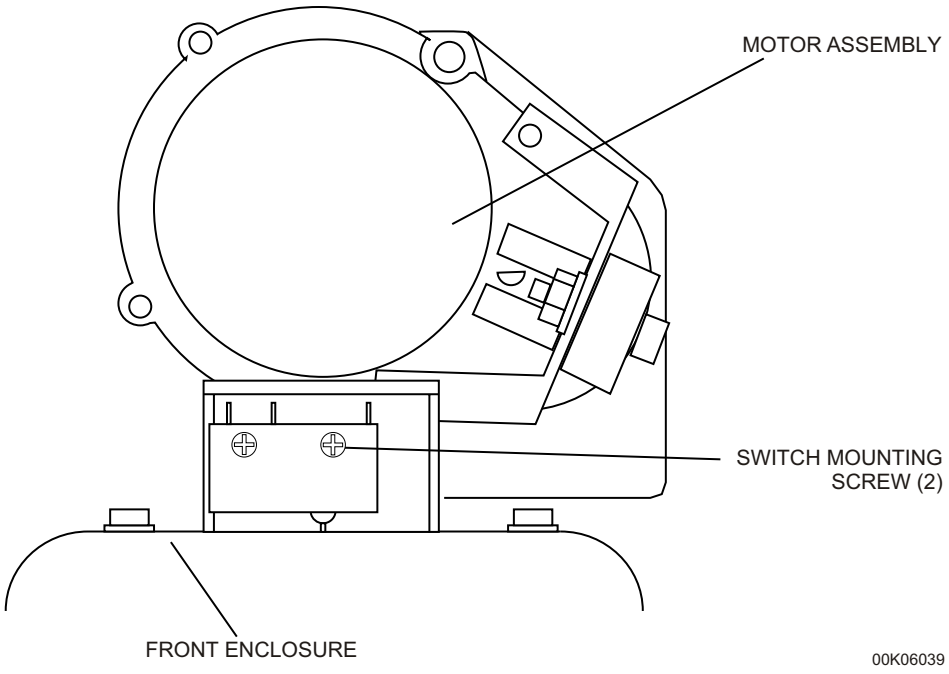

Figure 7-2. Injector Sensor Switch

7.2.4
VIAL SENSOR SWITCH ADJUSTMENT

The recommended tools and materials for this procedure are a 3/16 inch nutdriver and red GLPT insulating varnish.

To adjust the vial sensor switch, refer to *Figure 7-3, Vial Sensor Switch*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Using the nutdriver, loosen the two vial sensor switch adjustment screws until the switch holder can be easily moved. Do not loosen the screws so much that the switch bracket rocks from side to side.
4. Place the switch bracket upright. Move the switch up slowly until it clicks off, then move the switch down slowly until it clicks on. Move the switch down approximately 1/16 inch to verify the switch detects a vial. Tighten the screws while keeping the switch bracket level.
5. Apply red GLPT insulating varnish to the screw heads.
6. Reassemble the pump in the exact reverse order of disassembly.
7. Close and lock the security door.
8. Connect the infusion pump to AC power.

To verify successful adjustment of the vial sensor switch, perform the PVT in *Section 5.2*.

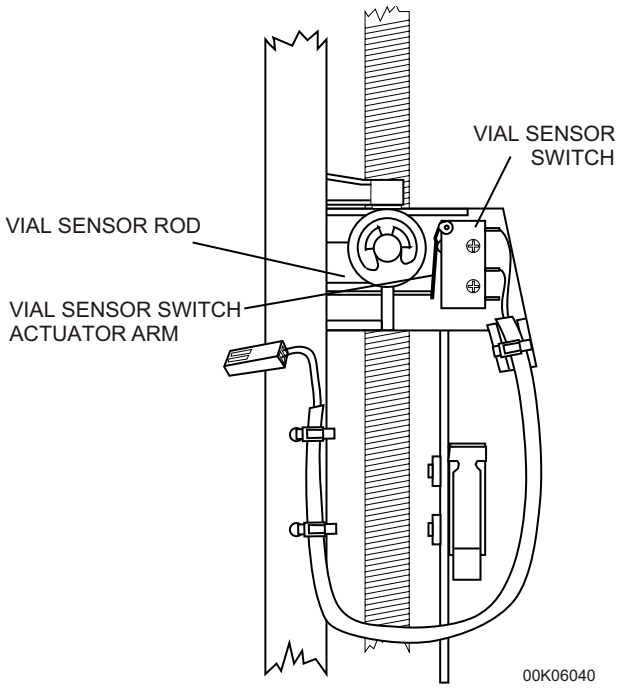

Figure 7-3. Vial Sensor Switch

7.2.5
OCCLUSION ALARM SWITCH TEST AND ADJUSTMENT

The recommended tools and materials for the following procedures are a No. 0 Phillips screwdriver; water-filled syringe; DPM; three-way stopcock; and an IV administration set.

7.2.5.1
OCCLUSION ALARM SWITCH TEST

To perform the occlusion alarm switch test, refer to *Figure 7-4, Occlusion Alarm Test Setup*, then proceed as follows:

1. Using the three-way stopcock, attach the DPM to the end of the patient line.
2. Install the water-filled syringe and IV administration set into the infusion pump.
3. Verify the self test has completed, and press [CONTINUE].
4. Verify the “CUSTOM VIAL” message is displayed, and press [CONFIRM].
5. Verify the “CLEAR HISTORY” message is displayed, and press [YES].
6. Verify the “CONFIRM CLEAR HISTORY” message is displayed, and press [CONFIRM].
7. Verify the “PURGE?” message is displayed, and press [YES].

8. Verify the “DISCONNECT SET FROM PATIENT/PRESS AND HOLD PURGE KEY” message is displayed. Press and hold the [PURGE] softkey until flow is seen at the three-way stopcock. Release the [PURGE] softkey.
9. Verify the “PURGE COMPLETE?” message is displayed. Check for air-in-line and assure the set is primed, then press [YES].
10. Disregard the “RECONNECT SET TO PATIENT” message.
11. Verify the “SELECT UNITS OF MEASURE” message is displayed, and press [MILLIGRAMS].
12. Verify the “ENTER DRUG CONCENTRATION” message is displayed. Press [1], then press [ENTER].
13. Verify the “CONFIRM CONCENTRATION” message is displayed, and press [CONFIRM].
14. Verify the “SET LOADING DOSE” message is displayed, and press [YES].
15. Verify the “ENTER LOADING DOSE” message is displayed. Press [1] then [0], then press [ENTER].
16. Verify the “PRESS START BUTTON TO INFUSE” message is displayed, and press [START/PAUSE].
17. Verify the “PRESS PAUSE BUTTON TO STOP” message is displayed.
18. Verify the pump sounds an alarm and displays “OCCLUSION”, and the “CHECK PCA 3 SET TO RELIEVE PRESSURE” message appears.
19. Press [SILENCE] and verify the DPM reads 15 ± 5 psi.
20. If the reading is not 15 ± 5 psi, perform the occlusion alarm adjustment procedure in *Section 7.2.5.2, Occlusion Alarm Switch and Pressure Adjustment*.
21. Open the stopcock to clear the occlusion alarm.
22. Remove the vial from the infusion pump.

If the reading is between the specified parameters, perform the PVT in *Section 5.2*.

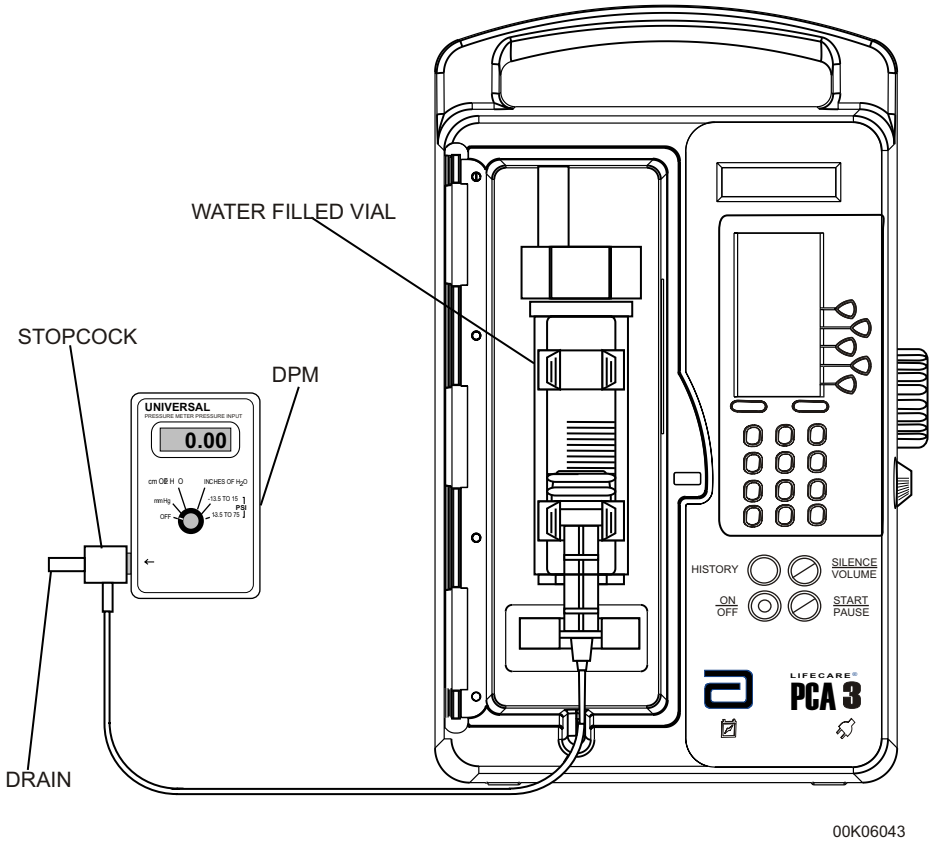

Figure 7-4. Occlusion Alarm Test Setup

7.2.5.2

OCCLUSION ALARM SWITCH AND PRESSURE ADJUSTMENT

To adjust the occlusion alarm switch and pressure, refer to *Figure 7-5, Occlusion Alarm Pressure Adjustment*, then proceed as follows:

1. Examine the position of the occlusion alarm switch. If the switch actuator is in contact with the switch button, proceed to step 2. If the switch actuator is not making contact with the switch button, use the Phillips screwdriver to loosen the screw on the switch actuator. Adjust the screw until the switch actuator contacts the switch button, but does not trip the switch.
2. Connect the cables from the rear enclosure assembly to the MCU PWA to allow the pump to operate with the enclosure open *(see Figure 7-1)*. Support the front enclosure assembly to keep it upright for the adjustment procedure.
3. Install the water-filled syringe, and connect the IV administration set, DPM, and stopcock. Open the stopcock valve to air.
4. Perform the occlusion alarm switch test as described in *Section 7.2.5.1*.
5. If the occlusion alarm sounds before the pressure reaches 10 psi, relieve the fluid pressure by opening the stopcock valve. Loosen the set screw on the thumb nut and turn the thumb nut clockwise to tighten. Repeat step 4.

6. If the occlusion alarm does not sound at or before 20 psi, relieve the fluid pressure by opening the stopcock valve. Loosen the set screw on the thumb nut and turn the thumb nut counter clockwise to loosen. Repeat steps 4 and 5.
7. When the pump occludes at between 10 and 20 psi, retighten the set screw on the thumb nut.

To verify successful adjustment of the occlusion alarm switch and pressure, perform the PVT in *Section 5.2*.

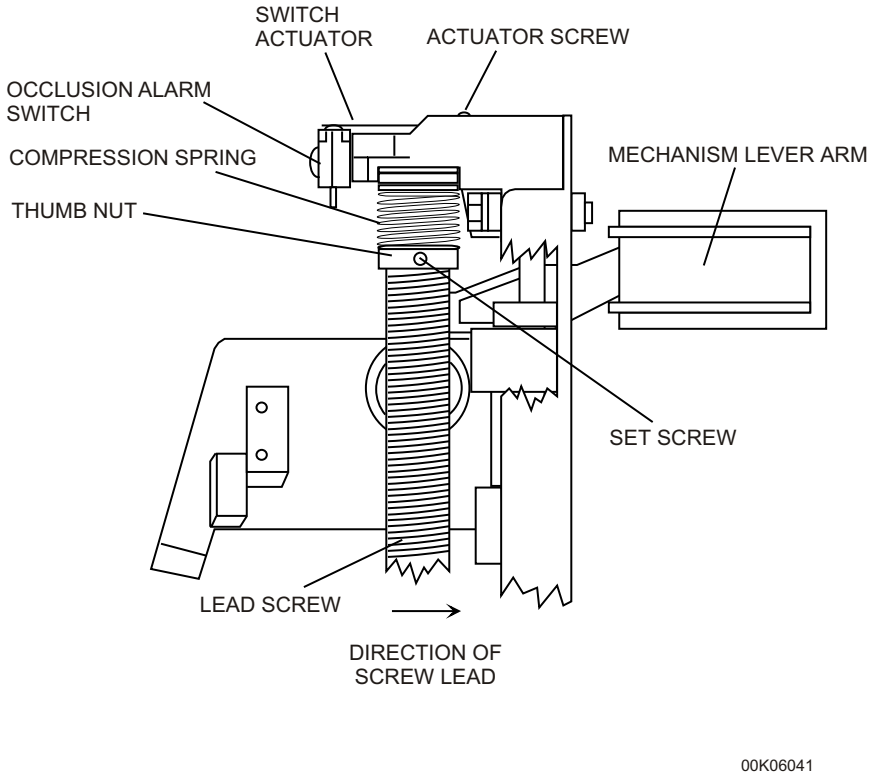

Figure 7-5. Occlusion Alarm Pressure Adjustment

7.2.6
LEAD SCREW LUBRICATION

The recommended tools and materials for this procedure are isopropyl alcohol, cotton swabs or a small brush, and Braycote grease.

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Using isopropyl alcohol and cotton swabs or a small brush, remove all grease and residue from the lead screw.

   Note: Assure that all residual lubricant is removed.

4. Apply a thin coating of grease and work it into the threads along the length of the shaft. Do not fill the threads. Move the slide clamp as necessary to clean and lubricate the length of the lead screw.

To verify successful lead screw lubrication, perform the PVT in *Section 5.2*.

7.3 REPLACEMENT PROCEDURES

This section contains safety and equipment precautions, required tools and materials, and step-by-step procedures for replacing parts in the infusion pump. Unless otherwise stated, always perform the PVT after a replacement procedure.

7.3.1 SAFETY AND EQUIPMENT PRECAUTIONS

Before opening the front enclosure of the infusion pump, take all necessary precautions for working on high-voltage equipment.

WARNING: POSSIBLE EXPLOSION HAZARD EXISTS IF THE INFUSION PUMP IS SERVICED IN THE PRESENCE OF FLAMMABLE ANESTHETICS.

WARNING: UNLESS OTHERWISE INDICATED, DISCONNECT THE INFUSION PUMP FROM AC POWER BEFORE PERFORMING ADJUSTMENT OR REPLACEMENT PROCEDURES.

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store PWAs in antistatic bags before placing them on any surface.

7.3.2 REQUIRED TOOLS AND MATERIALS

The following tools and materials, or equivalents, are required for the replacement procedures in this section. In addition, the beginning of each procedure lists tools and materials recommended for that specific procedure.

- ❏ Set of standard and metric nutdrivers
- ❏ Set of flat blade screwdrivers
- ❏ Set of Phillips screwdrivers
- ❏ Set of box wrenches
- ❏ Set of open end wrenches
- ❏ Needle nose pliers
- ❏ Diagonal cutters
- ❏ X-acto knife
- ❏ Red GLPT insulating varnish
- ❏ Permanent marker
- ❏ Isopropyl alcohol
- ❏ Lint-free cloth

7.3.3
FRONT AND REAR ENCLOSURE REPLACEMENT

The recommended tool for this procedure is a No. 2 Phillips screwdriver.

The replacement parts for this procedure are:

Enclosure, Front
Enclosure, Rear
Screw, 6-32 x 1/2, Pan Head, Phillips
Washer, Lock, #6

To replace the front and rear enclosure assemblies, refer to *Figure 7-1*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. To replace the front enclosure, remove the specific components described in *Section 7.3.8, Front Enclosure Assembly Component Replacement*. To replace the rear enclosure, remove the specific components described in *Section 7.3.9, Rear Enclosure Assembly Component Replacement*.
4. Reassemble the replacement front or rear enclosure assembly. Refer to the specific procedures in *Section 7.3.8* or *Section 7.3.9*.
5. Join the front enclosure assembly and rear enclosure assembly in the exact reverse order of separation.

To verify successful replacement of the front and rear enclosure assemblies, perform the PVT in *Section 5.2*.

7.3.4
RUBBER FOOT PAD REPLACEMENT

Recommended tools and materials for this procedure are an X-acto knife and isopropyl alcohol.

The following replacement part is available:

Pad, Rubber Foot

To replace the rubber foot pad, refer to *Figure 7-6*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Place the pump on its side.
3. Using the X-acto knife, remove the rubber foot pad and scrape the enclosure recess to remove adhesive residue.

   Note: Each adhesive-backed rubber foot pad is bonded in its recess. Do not damage the recess.
4. Using isopropyl alcohol, clean any adhesive residue from the enclosure recess.
5. Remove the protective backing from the self-adhesive surface of the replacement foot pad and press the pad in place.
6. After approximately five minutes, verify the foot pad is secure.

Replacement of a rubber foot pad is routine maintenance and no verification procedure is normally required. However, if the infusion pump may have been damaged during a rubber foot pad replacement, perform the PVT in *Section 5.2*.

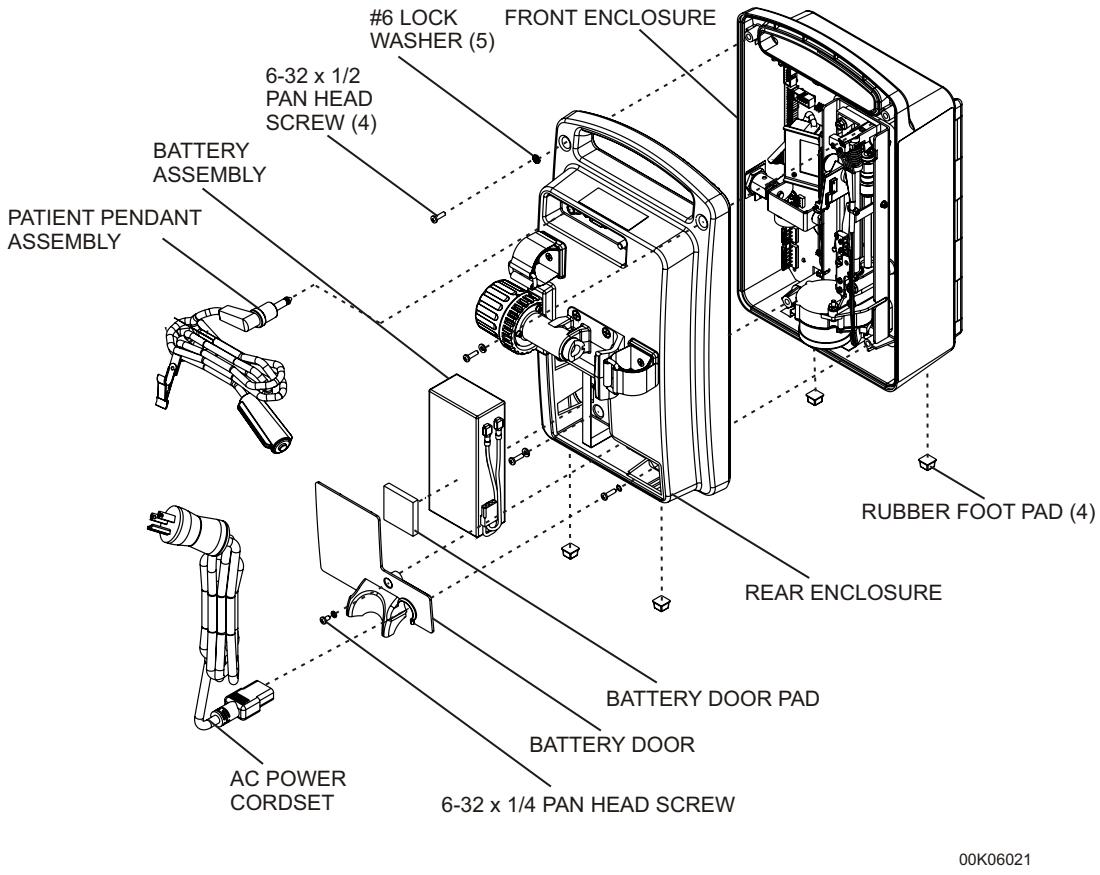

Figure 7-6. Battery Assembly, AC Power Cord, and Patient Pendant Assembly

7.3.5
AC POWER CORD REPLACEMENT

The recommended tool for this procedure is a No. 2 Phillips screwdriver.

The following replacement part is available:

Cordset, AC Power, Hospital Grade

To replace the AC power cord, refer to *Figure 7-6*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Using the Phillips screwdriver, remove the 6-32 screw that attaches the battery door to the rear of the pump.
3. Disconnect the AC power cord by grasping the plug. Do not pull on the power cord.
4. Replace the AC power cord by plugging it into the pump's AC power receptacle.
5. Reinstall the battery door with the screw that was removed in step 2.
6. Conduct the electrical safety test in *Section 5.2.8*.

Replacement of the AC power cord is routine maintenance and no verification procedure is normally required. However, if the infusion pump may have been damaged during this procedure, perform the PVT in *Section 5.2*.

7.3.6
BATTERY, BATTERY DOOR, BATTERY DOOR PAD, AND BATTERY STRAP REPLACEMENT

Recommended tools and materials for this procedure are a No.1 Phillips screwdriver, No. 2 Phillips screwdriver, isopropyl alcohol, and a lint-free cloth.

The replacement parts for this procedure are:

Assembly, Battery, with Wire Harness
Door, Battery
Pad, Battery Door
Strap, Battery
Screw, 6-32 x 1/4, Pan Head, Phillips
Screw, 4-24 x 3/8, Thread Cutting, Phillips
Washer, Lock, #6

To replace the battery, battery door, and battery door pad, refer to *Figure 7-6* and *Figure 7-11, Rear Enclosure External Components*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Using the No. 2 Phillips screwdriver, remove the 6-32 screw that attaches the battery door to the rear of the pump and remove the battery door.
3. Inspect the battery door and door pad for damage. If the pad is defective, remove it from the door and clean the door with isopropyl alcohol. Dry the battery door thoroughly, and install the replacement pad on the battery door.
4. Inspect the battery strap for damage *(see Figure 7-11)*. If the battery strap is defective, using the No. 1 Phillips screwdriver, remove the 4-24 thread cutting screw securing the battery strap to the rear enclosure.

5. Install the replacement battery strap in the exact reverse order of removal.
6. Pull the battery wire harness and cable outside the enclosure. Disconnect the battery assembly from the infusion pump. Pull up on the battery strap and remove the battery from the enclosure. Dispose of the battery in accordance with local battery disposal practices.
7. Connect the replacement battery to the battery connector. Assure the connection is tight.

   Note: The cable connectors are keyed so that cables cannot be connected incorrectly.

   Note: Install the replacement battery into the housing so the wires are not kinked or crushed, or do not interfere with the AC power cord.
8. Replace the battery door using the screw that was removed in step 2.

Note: The pump must be powered on with AC disconnected for the device to recognize that a new battery has been installed.

To verify successful replacement of the battery, press [ON] with the infusion pump disconnected from AC power. Verify the front panel battery symbol illuminates.

Replacement of the battery door, battery door pad, and battery strap is routine maintenance and no verification procedure is normally required. However, if the infusion pump may have been damaged during these procedures, perform the PVT in *Section 5.2*.

7.3.7
PATIENT PENDANT ASSEMBLY REPLACEMENT

No tools are required for this procedure.

The following replacement part is available:

Assembly, Patient Pendant

To replace the patient pendant assembly, refer to *Figure 7-6*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Disconnect the patient pendant assembly from the patient pendant jack on the rear of the pump.
3. Connect the replacement patient pendant assembly to the patient pendant jack.

   Note: Verify the PCA 3 replacement patient pendant cord is color-coded blue and the switch button is black.

Replacement of the patient pendant assembly is routine maintenance and no verification procedure is normally required. However, if the infusion pump may have been damaged during this procedure, perform the PVT in *Section 5.2*.

7.3.8
FRONT ENCLOSURE ASSEMBLY COMPONENT REPLACEMENT

Front enclosure assembly component replacement includes replacement of the following:

- ❏ Security door
- ❏ Door hinge
- ❏ Keypad
- ❏ Door latch hook
- ❏ Cradle assembly
- ❏ Mechanism lever arm
- ❏ Door latch assembly
- ❏ Door lock assembly
- ❏ Handle gasket
- ❏ Enclosure gasket
- ❏ Electronics assembly and components
- ❏ PWAs
- ❏ LCD window
- ❏ Mechanism assembly
- ❏ Barcode reader, gasket, and window
- ❏ Splash shield

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store PWAs in antistatic bags before placing them on any surface.

To replace the front enclosure assembly components, refer to *Figure 7-7, Front Enclosure Assembly External Components*, and *Figure 7-8, Front Enclosure Assembly Internal Components*, then proceed as detailed in the following sections.

7.3.8.1
SECURITY DOOR AND DOOR HINGE REPLACEMENT

The recommended tool for this procedure is a No. 1 Phillips screwdriver.

The replacement parts for this procedure are:

Door, Security
Hinge, Security Door
Screw, 4-40 x 3/8, Pan Head, Phillips

To replace the security door and door hinge, refer to *Figure 7-7*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Unlock the security door, and open the door approximately 270 degrees to reveal the four screws that attach the hinge.
4. Using the Phillips screwdriver, remove the four 4-40 screws and remove the hinge and the door.
5. Attach the replacement door and/or hinge using the screws that were removed in step 4.
6. Close and lock the security door. Verify that the door aligns with the door latch assembly and that the door is locked.

Replacement of the security door and door hinge is routine maintenance and no verification procedure is normally required. However, if the infusion pump may have been damaged during these procedures, perform the PVT in *Section 5.2*.

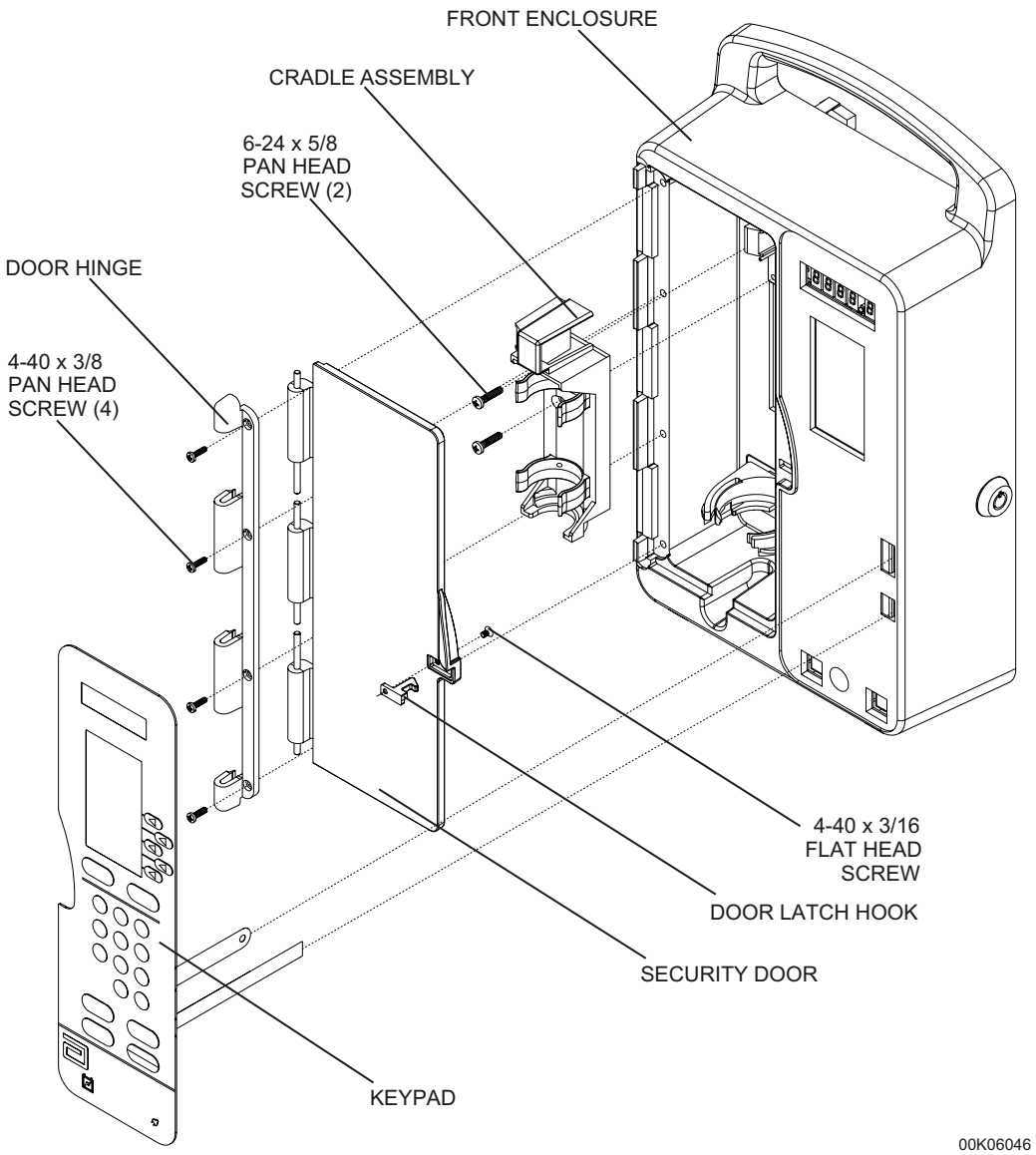

Figure 7-7. Front Enclosure Assembly External Components

7.3.8.2
KEYPAD REPLACEMENT

Recommended tools and materials for this procedure are a 1/4 inch nutdriver, an X-acto knife, isopropyl alcohol, and a lint-free cloth.

The following replacement part is available:

Keypad
Bracket, Grounding, Keypad

To replace the keypad, refer to *Figure 7-7* and *Figure 7-8*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Disconnect the ribbon cables from the MCU PWA by pulling up on the connector slide clips.
4. Using the nutdriver, remove the hex screw that attaches the ground strap from the keypad to the keypad grounding bracket.
5. Using the X-acto knife and needle nose pliers, remove the keypad.
6. Using isopropyl alcohol, remove any adhesive remaining on the front enclosure assembly.
7. Remove the backing from the replacement keypad to expose the adhesive, and guide the ribbon cables and ground strap through the front enclosure assembly.
8. Press the keypad into place on the front enclosure assembly and connect the ribbon cables to the MCU PWA.
9. Reinstall the ground strap and grounding bracket using the hex screw that was removed in step 4.
10. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the keypad, perform the PVT in *Section 5.2*.

7.3.8.3
DOOR LATCH HOOK REPLACEMENT

The recommended tool for this procedure is a No. 1 Phillips screwdriver.

The replacement parts for this procedure are:

Hook, Door Latch
Screw, 4-40 x 3/16, Flat Head, Phillips

To replace the door latch hook, refer to *Figure 7-7*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Unlock and open the security door.
3. From inside the door, using the Phillips screwdriver, remove the 4-40 flat head screw that attaches the latch hook to the door.
4. Install the replacement latch hook through the door using the screw that was removed in step 3.
5. Close and lock the security door.

Replacement of the door latch hook is routine maintenance and no verification procedure is normally required. However, if the infusion pump may have been damaged during this procedure, perform the PVT in *Section 5.2*.

7.3.8.4
CRADLE ASSEMBLY REPLACEMENT

The recommended tool for this procedure is a No. 2 Phillips screwdriver.

The replacement parts for this procedure are:

Assembly, Cradle
Screw, 6-24 x 5/8, Pan Head, Phillips

To replace the cradle assembly, refer to *Figure 7-7*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Open the security door.
4. Place the pump face up on a soft surface.
5. Using the Phillips screwdriver, remove the two 6-24 screws that secure the cradle assembly and remove the cradle assembly.
6. Install the replacement cradle assembly using the screws that were removed in step 5.
7. Close and lock the security door.

To verify successful replacement of the cradle assembly, perform the PVT in *Section 5.2*.

7.3.8.5
MECHANISM LEVER ARM REPLACEMENT

The recommended tool for this procedure is a medium size flat blade screwdriver.

The following replacement part is available:

Arm, Lever, Mechanism

To replace the mechanism lever arm, refer to *Figure 7-8*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Remove the cradle assembly as described in *Section 7.3.8.4*.
4. Using the flat blade screwdriver, lift the mechanism lever arm off the pivot post and pull the lever arm through the front of the pump.
5. Install the replacement mechanism lever arm in the exact reverse order of removal.
6. Reinstall the cradle assembly.
7. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the mechanism lever arm, perform the PVT in *Section 5.2*.

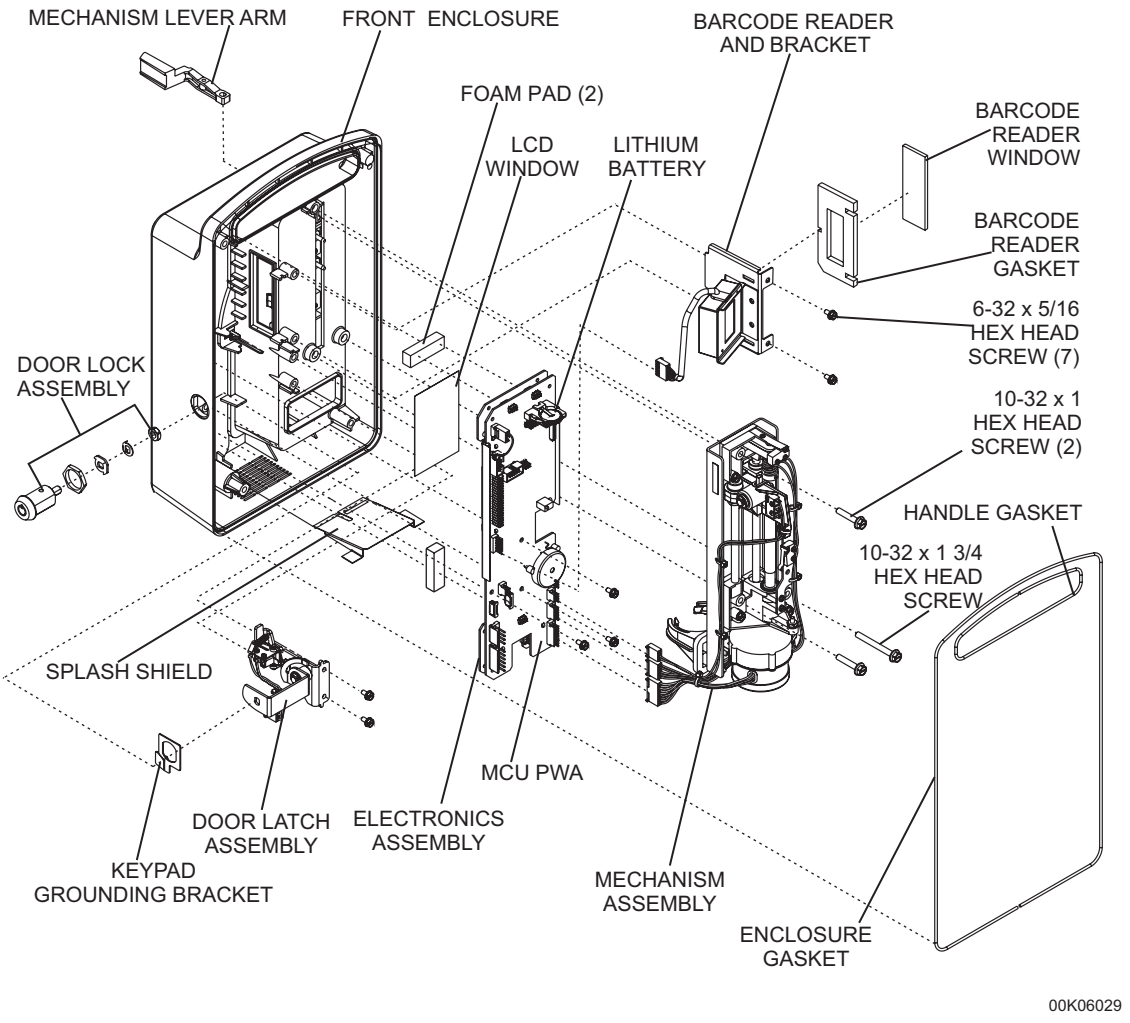

Figure 7-8. Front Enclosure Assembly Internal Components

7.3.8.6
DOOR LATCH ASSEMBLY REPLACEMENT

Recommended tools for this procedure are a 7/8 inch open end wrench, medium size flat blade screwdriver, and 1/4 inch nutdriver.

The replacement parts for this procedure are:

Assembly, Door Latch
Screw, 6-32 x 5/16, Hex Head, with Washer

To replace the door latch assembly, refer to *Figure 7-8*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Disconnect the door lock cable from the MCU PWA.
4. Using the open end wrench, loosen the retainer nut that secures the lock cylinder to the front enclosure assembly *(see Section 7.3.8.7, Door Lock Assembly Replacement)*. Move the lock cylinder away from the door latch assembly.
5. Remove the barcode reader *(see Section 7.3.8.13, Barcode Reader, Gasket, and Window Replacement)*.
6. Using the nutdriver or flat blade screwdriver, remove the two 6-32 hex head screws securing the door latch assembly to the front enclosure.
7. Install the replacement door latch assembly using the screws that were removed in step 6.

   Note: Confirm the door latch cam is positioned to assure proper operation of the latch.

8. Reconnect the door lock cable to the MCU PWA.
9. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the door latch assembly, perform the PVT in *Section 5.2*.

7.3.8.7
DOOR LOCK ASSEMBLY REPLACEMENT

The recommended tools for this procedure are a 7/16 inch open end wrench, a 7/8 inch open end wrench, and needle nose pliers.

The following replacement part is available:

Assembly, Door Lock

The door lock assembly kit includes a cylinder lock, a keying washer, a three-finger washer, and a 7/16 hex nut. The following pre-assembly of the replacement lock is required *(see Figure 7-8* and *Figure 7-9, Door Lock Assembly)*.

1. Place the keying washer over the threaded shaft of the cylinder lock with the shiny (rounded) side down. Verify that the keying washer is lined up with the raised portion of the cylinder lock.
2. Place the three-finger washer over the threaded shaft. Assure that the ridged side of the fingers faces up.

3. Using the 7/16 open end wrench, tighten the nut over the washers.
4. Using the needle nose pliers, bend the washer fingers up to hold the nut in place.
5. Holding the lock in your right hand, insert the key into the lock and verify that the key turns 90 degrees to the left.

Once the replacement lock cylinder is assembled, proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Close and lock the security door.
3. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
4. Using the 7/8 inch open end wrench, remove the door lock retainer nut while sliding the door lock cylinder through the keypad grounding bracket and front enclosure. Note the position of the door latch cam.
5. Install the replacement door lock cylinder into the double-D hole in the front enclosure. Confirm the keyway slot is in the upward (12 o'clock) position.
6. Assemble the keypad grounding bracket and retaining nut on the door lock cylinder and insert the threaded shaft into the double-D hole in the door latch cam.
7. Using the 7/8 inch open end wrench, secure the lock to the front enclosure.
8. Confirm the door latch cam is in the up position.
9. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the door lock assembly, perform the PVT in *Section 5.2*.

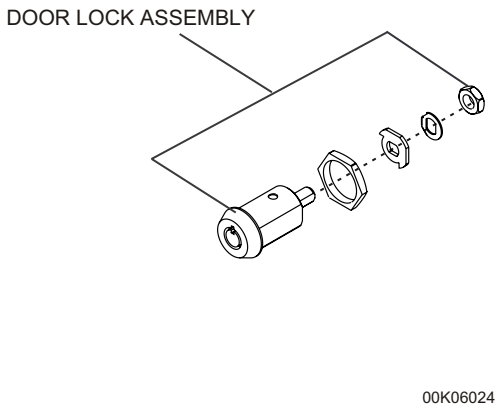

Figure 7-9. Door Lock Assembly

7.3.8.8
HANDLE GASKET AND ENCLOSURE GASKET REPLACEMENT

The recommended tool for this procedure is an X-acto knife.

The replacement parts for this procedure are:

Gasket, Handle
Gasket, Enclosure

To replace the handle and enclosure gaskets, refer to *Figure 7-8*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Using the X-acto knife, carefully remove the defective gasket.
4. Install the replacement handle and/or enclosure gasket in the front enclosure.

   Note: Assure the enclosure gasket is installed so that the seam is at the bottom of the enclosure and the handle gasket seam is at the top of the handle opening.
5. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the handle and enclosure gaskets, perform the PVT in *Section 5.2*.

7.3.8.9
ELECTRONICS ASSEMBLY REPLACEMENT

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store PWAs in antistatic bags before placing them on any surface.

Note: Replacing the electronics assembly removes the pump's serial number from memory.

The recommended tools and materials for this procedure are a 1/4 inch nutdriver and mild solvent.

The replacement parts for this procedure are:

Assembly, Electronics
Pad, Foam
Screw, 6-32 x 5/16, Hex Head, with Washer

To replace the electronics assembly, refer to *Figure 7-8* and *Figure 7-10, Electronics Assembly Components*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Remove the barcode reader as described in *Section 7.3.8.13*.
4. Remove the door latch assembly as described in *Section 7.3.8.6*.

5. Grasp the ribbon connector locking tabs of J10 and J11 and pull up to disengage. Disconnect the ribbon cables from the MCU PWA. Disengage the connectors attaching J13, J16, and J18 to the MCU PWA.
6. Using the nutdriver, remove the three 6-32 hex screws that secure the electronics assembly to the front enclosure assembly.
7. Remove the electronics assembly from the front enclosure assembly by pulling the bottom of the MCU PWA up and out.
8. Inspect the two foam pads in the front enclosure assembly. If they appear damaged, replace them, removing any residue with mild solvent.
9. Install the replacement electronics assembly in the exact reverse order of removal.
10. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the electronics assembly, perform the PVT in *Section 5.2*.

7.3.8.10
ELECTRONICS ASSEMBLY COMPONENT REPLACEMENT

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store PWAs in antistatic bags before placing them on any surface.

Electronics assembly component replacement includes the replacement of the following:

- ❏ LCD shield
- ❏ LCD assembly
- ❏ Numeric display PWA
- ❏ Icon display PWA
- ❏ MCU PWA
- ❏ Lithium backup battery

To replace the electronics assembly components, refer to *Figure 7-8* and *Figure 7-10*, then proceed as detailed in the following sections.

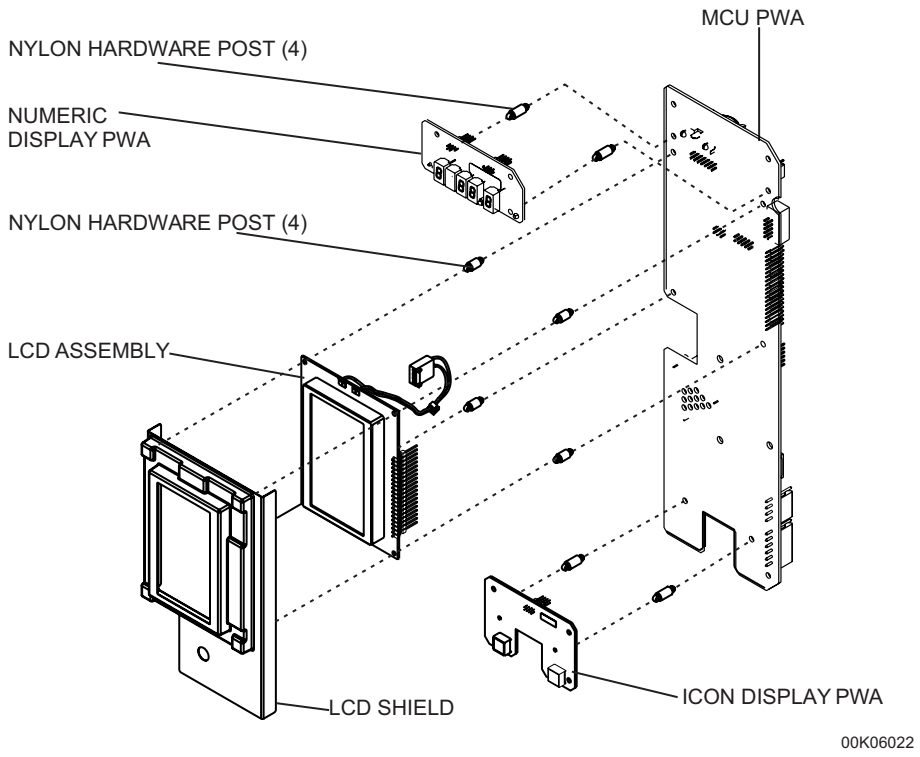

Figure 7-10. Electronics Assembly Components

7.3.8.10.1

LCD Shield Replacement

Recommended tools and materials for this procedure are an X-acto knife, isopropyl alcohol, and a lint-free cloth.

The following replacement part is available:

Shield, LCD

To replace the LCD shield, refer to *Figure 7-8* and *Figure 7-10*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Remove the barcode reader as described in *Section 7.3.8.13*.
4. Remove the door latch assembly as described in *Section 7.3.8.6*.
5. Remove the electronics assembly as described in *Section 7.3.8.9*.
6. Using the X-acto knife, lift the LCD shield from the LCD assembly.
7. Using the lint-free cloth moistened with isopropyl alcohol, clean any remaining adhesive from the LCD assembly.
8. Remove the protective backing from the replacement LCD shield to expose the adhesive. Center the shield over the LCD and press the shield into place on the LCD.
9. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the LCD shield, perform the PVT in *Section 5.2*.

7.3.8.10.2

LCD Assembly Replacement

The recommended tools for this procedure are diagonal cutters and needle nose pliers.

The replacement parts for this procedure are:

Assembly, LCD
Post, Nylon

To replace the LCD assembly, refer to *Figure 7-8* and *Figure 7-10*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Remove the barcode reader as described in *Section 7.3.8.13*.
4. Remove the door latch assembly as described in *Section 7.3.8.6*.
5. Remove the electronics assembly as described in *Section 7.3.8.9*.
6. Remove the LCD shield as described in *Section 7.3.8.10.1*.
7. Disconnect P3 from J3 on the MCU PWA.
8. Using the diagonal cutters, snip off the ends of the four nylon hardware posts attaching the LCD assembly to the MCU PWA. Remove the defective LCD assembly.
9. Remove the remaining portion of the nylon hardware posts from the MCU PWA with needle nose pliers.
10. Place the MCU PWA on a stable surface. Align the nylon hardware posts on the replacement LCD assembly with the four holes on the MCU PWA, and press carefully to attach the LCD assembly.

    CAUTION: Exercise care when replacing or reinstalling the nylon posts. Applying excessive pressure on the posts may bend or damage the PWAs.

11. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the LCD assembly, perform the PVT in *Section 5.2*.

7.3.8.10.3

Numeric Display PWA Replacement

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store the PWA in an antistatic bag before placing it on any surface.

The recommended tools for this procedure are diagonal cutters and needle nose pliers.

The replacement parts for this procedure are:

PWA, Numeric Display
Post, Nylon

To replace the numeric display PWA, refer to *Figure 7-8* and *Figure 7-10*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Remove the barcode reader as described in *Section 7.3.8.13*.
4. Remove the door latch assembly as described in *Section 7.3.8.6*.
5. Remove the electronics assembly as described in *Section 7.3.8.9*.
6. Using the diagonal cutters, snip off the ends of the four nylon hardware posts attaching the numeric PWA to the MCU PWA. Remove the defective numeric PWA.
7. Remove the remaining portion of the nylon hardware posts from the MCU PWA using needle nose pliers.
8. Place the MCU PWA on a stable surface. Align the nylon hardware posts on the replacement numeric PWA with the two holes on the MCU PWA, and press carefully to attach the numeric PWA.

   CAUTION: Exercise care when replacing or reinstalling the nylon posts. Applying excessive pressure on the posts may bend or damage the PWAs.

9. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the numeric display PWA, perform the PVT in *Section 5.2*.

7.3.8.10.4

Icon Display PWA Replacement

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store the PWA in an antistatic bag before placing it on any surface.

The recommended tools for this procedure are diagonal cutters and needle nose pliers.

The replacement parts for this procedure are:

PWA, Icon Display
Post, Nylon

To replace the icon display PWA, refer to *Figure 7-8* and *Figure 7-10*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Remove the barcode reader as described in *Section 7.3.8.13*.
4. Remove the door latch assembly as described in *Section 7.3.8.6*.
5. Remove the electronics assembly as described in *Section 7.3.8.9*.
6. Using the diagonal cutters, snip off the ends of the four nylon hardware posts attaching the icon display PWA to the MCU PWA. Remove the defective icon display PWA.
7. Remove the remaining portion of the nylon hardware posts from the MCU PWA with needle nose pliers.
8. Place the MCU PWA on a stable surface. Align the nylon hardware posts on the replacement icon display PWA with the two holes on the MCU PWA, and press carefully to attach the icon display PWA.

   CAUTION: Exercise care when replacing or reinstalling the nylon posts. Applying excessive pressure on the posts may bend or damage the PWAs.

9. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the icon display PWA, perform the PVT in *Section 5.2*.

7.3.8.10.5

MCU PWA Replacement

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store the PWA in an antistatic bag before placing it on any surface.

Note: Replacing the MCU PWA removes the pump's serial number from memory.

The recommended tool for this procedure is diagonal cutters.

The replacement parts for this procedure are:

PWA, MCU

To replace the MCU PWA, refer to *Figure 7-8* and *Figure 7-10*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Remove the barcode reader as described in *Section 7.3.8.13*.
4. Remove the door latch assembly as described in *Section 7.3.8.6*.
5. Remove the electronics assembly as described in *Section 7.3.8.9*.
6. Using the diagonal cutters, snip off the ends of the nylon hardware posts attaching the LCD assembly to the MCU PWA. Remove the LCD assembly.
7. Using the diagonal cutters, snip off the ends of the nylon hardware posts attaching the numeric PWA to the MCU PWA. Remove the numeric PWA.
8. Using the diagonal cutters, snip off the ends of the nylon hardware posts attaching the icon display PWA to the MCU PWA. Remove the icon display PWA.
9. Beginning with the LCD assembly, carefully attach the three smaller PWAs to the replacement MCU PWA.
10. Reassemble the infusion pump in the exact reverse order of disassembly.

Note: Replacement of the MCU PWA may result in malfunction alarms. To clear the alarms, see *Section 6*.

To verify successful replacement of the MCU PWA, perform the PVT in *Section 5.2*.

7.3.8.10.6

Lithium Battery Replacement

Note: Replacing the lithium battery removes the pump's serial number from memory.

No tools are required for this procedure.

The following replacement part is available:

Battery, Lithium

To replace the lithium battery, refer to *Figure 7-8*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Place the front enclosure face down on a soft, flat surface.

4. Remove the lithium battery by grasping it with thumb and forefinger, rotating slightly clockwise, and pulling up and to the left.
5. Observing polarity (+ side down), align the replacement lithium battery with the battery holder and push straight down until the battery snaps into place.
6. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the lithium battery, perform the PVT in *Section 5.2*.

7.3.8.11
LCD WINDOW REPLACEMENT

The recommended tool for this procedure is an X-acto knife.

The following replacement part is available:

Window, LCD

To replace the LCD window, refer to *Figure 7-8*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Remove the barcode reader as described in *Section 7.3.8.13*.
4. Remove the door latch assembly as described in *Section 7.3.8.6*.
5. Remove the electronics assembly as described in *Section 7.3.8.9*.
6. Using the X-acto knife, remove the LCD window from the front enclosure.
7. Remove the protective backing from the replacement LCD window to expose the adhesive.
8. Center the replacement LCD window over the opening in the front enclosure and press the window into place on the front enclosure.
9. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the LCD window, perform the PVT in *Section 5.2*.

7.3.8.12
MECHANISM ASSEMBLY REPLACEMENT

Recommended tools for this procedure are a No. 2 Phillips screwdriver and 5/16 inch nutdriver.

The replacement parts for this procedure are:

Assembly, Mechanism
Screw, 10-32 x 1, Hex Head
Screw, 10-32 x 1 3/4, Hex Head

To replace the mechanism assembly, refer to *Figure 7-8*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Remove the cradle assembly as described in *Section 7.3.8.4*.
4. Remove the mechanism lever arm as described in *Section 7.3.8.5*.

5. Disconnect the three mechanism cables from the MCU PWA.
6. Place the infusion pump face down on a soft surface. Using the nutdriver, remove the three 10-32 screws that secure the mechanism assembly to the front enclosure.
7. Install the replacement mechanism assembly using the screws that were removed in step 6.
8. Reinstall the mechanism lever arm and cradle assembly.
9. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the mechanism assembly, perform the PVT in *Section 5.2*.

7.3.8.13
BARCODE READER, GASKET, AND WINDOW REPLACEMENT

Recommended tools and materials for this procedure are a 1/4 inch nutdriver, an X-acto knife, isopropyl alcohol, and a lint-free cloth.

The replacement parts for this procedure are:

Reader, Barcode
Gasket, Barcode Reader
Window, Barcode Reader
Bracket, Barcode Reader

To replace the barcode reader, gasket, and window, refer to *Figure 7-8*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Disconnect the barcode reader cable from the MCU PWA.
4. Using the nutdriver, remove the two 6-32 screws from the barcode reader bracket.

   Note: The barcode window is not secured in place and will fall free when the barcode reader is removed.
5. Remove the barcode reader by pulling it up and off the mounting pins on the front enclosure.

   CAUTION: Handle the barcode window using only a lint-free cloth. Do not touch the window. Fingerprints or other contamination can degrade barcode reader performance.
6. Using the X-acto knife, remove the barcode reader gasket from the barcode reader bracket. Clean the bracket with isopropyl alcohol and dry thoroughly.
7. Remove the protective backing from the replacement barcode reader gasket and adhere the gasket to the barcode reader bracket.
8. Install the replacement barcode reader and window using the screws that were removed in step 4.
9. Reconnect the barcode reader cable to the MCU PWA.
10. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the barcode reader, gasket, and window, perform the PVT in *Section 5.2*.

7.3.8.14
SPLASH SHIELD REPLACEMENT

The recommended tool for this procedure is an X-acto knife.

The following replacement part is available:

Shield, Splash

To replace the splash shield, refer to *Figure 7-8*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Using the X-acto knife, remove the splash shield from the front enclosure.
4. Remove the protective backing from the replacement splash shield (two places) to expose the adhesive and install the shield into the front enclosure.
5. Reassemble the infusion pump in the exact reverse order of disassembly.

To verify successful replacement of the splash shield, perform the PVT in *Section 5.2*.

7.3.9
REAR ENCLOSURE ASSEMBLY COMPONENT REPLACEMENT

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store PWAs in antistatic bags before placing them on any surface.

Rear enclosure assembly component replacement includes the replacement of the following:

- ❏ Fuses
- ❏ Pole clamp assembly
- ❏ Velcro strap and retainer plate
- ❏ Power supply PWA
- ❏ Pawl/ratchet assembly
- ❏ Rear enclosure harness assembly
- ❏ Equipotential post
- ❏ Pole clamp nut plate
- ❏ Left/right ground straps
- ❏ Interface panel ground strap
- ❏ Battery pad
- ❏ Serial port cable assembly
- ❏ Patient pendant jack assembly

To replace the rear enclosure assembly components, refer to *Figure 7-11, Rear Enclosure External Components*, *Figure 7-12, Rear Enclosure Harness Assembly*, and *Figure 7-13, Rear Enclosure Internal Components*, then proceed as detailed in the following sections.

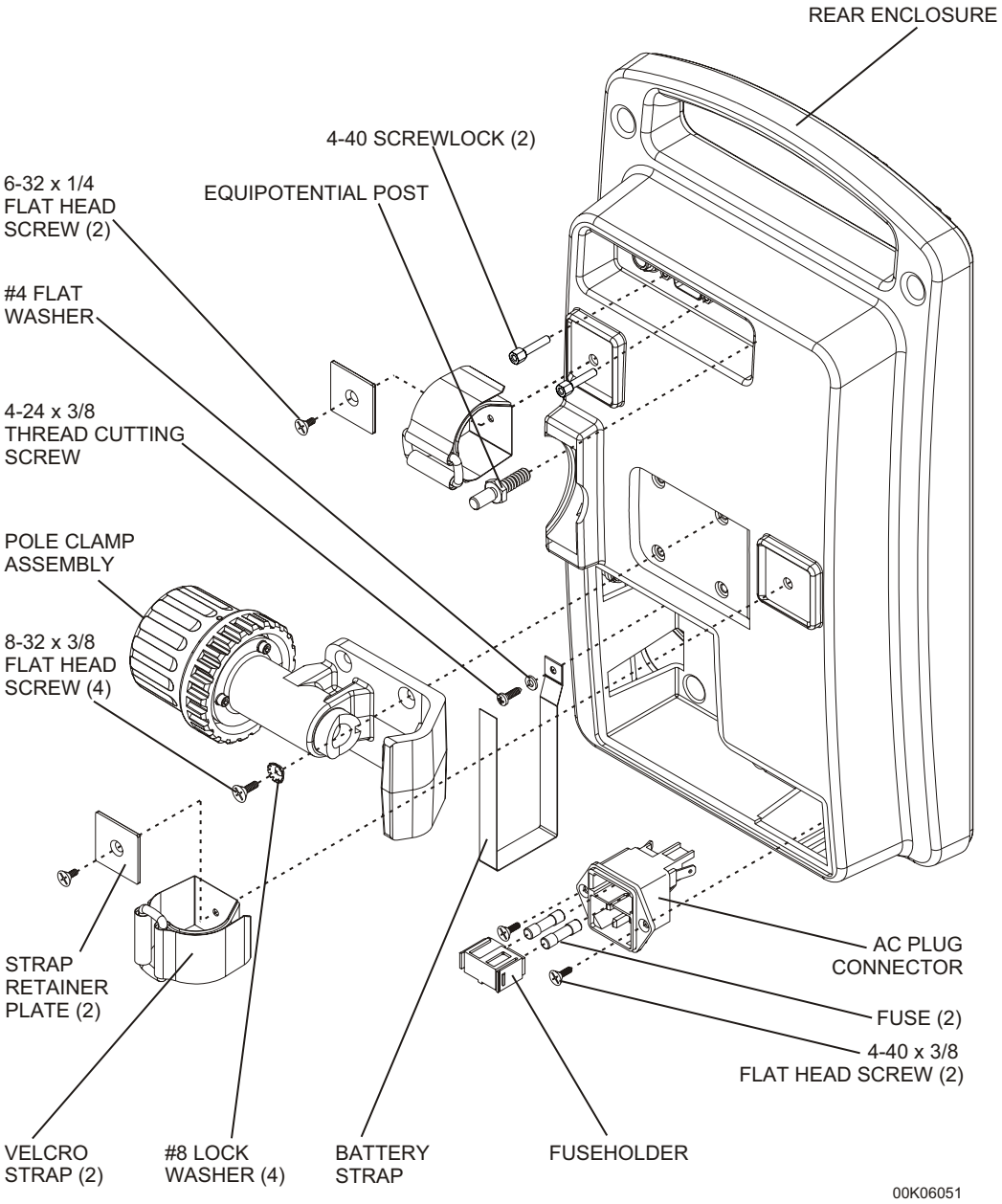

Figure 7-11. Rear Enclosure External Components

7.3.9.1
FUSE REPLACEMENT

The recommended tools for this procedure are a No. 2 Phillips screwdriver and a small flat blade screwdriver.

The following replacement part is available:

Fuse, .5 A, 250 V, Slo-Blo

To replace the fuses, refer to *Figure 7-11*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Using the Phillips screwdriver, remove the screw that attaches the battery door to the rear of the pump.
3. To access the fuses, remove the AC power cord from its receptacle by grasping the plug. Do not pull on the cord.
4. Locate the plastic fuseholder directly above the AC power receptacle. Insert the flat blade screwdriver between the locking tab at the center bottom of the fuseholder and the pump housing. Press the tab toward the center of the fuseholder to release it.
5. Remove the fuses and replace them with approved fuses only *(see Section 8, Specifications)*. Do not use any other fuse types.
6. Insert the fuseholder into the receptacle, then press the fuseholder down until it clicks into position.
7. Replace the AC power cord.
8. Reinstall the battery door with the screw that was removed in step 2.
9. Connect the infusion pump to AC power.

Fuse replacement is routine maintenance and no verification procedure is normally required. However, if the infusion pump may have been damaged during this procedure, perform the PVT in *Section 5.2*.

7.3.9.2
POLE CLAMP ASSEMBLY REPLACEMENT

The recommended tool for this procedure is a No. 2 Phillips screwdriver.

The replacement parts for this procedure are:

Assembly, Pole Clamp
Screw, 8-32 x 3/8, Flat Head, Phillips
Washer, Lock, #8

To replace the pole clamp assembly, refer to *Figure 7-11*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Place the pump face down on a soft surface.
3. Using the Phillips screwdriver, remove the four 8-32 screws and lock washers.
4. Remove the pole clamp assembly.

5. Install the replacement pole clamp assembly using the screws and lock washers that were removed in step 3.
6. Connect the infusion pump to AC power.

Replacement of the pole clamp assembly is routine maintenance and no verification procedure is normally required. However, if the infusion pump may have been damaged during this procedure, perform the PVT in *Section 5.2*.

7.3.9.3

VELCRO STRAP AND RETAINER PLATE REPLACEMENT

Velcro straps and retainer plates on the rear of the infusion pump secure the patient pendant and the AC power cord. This procedure details the replacement of the Velcro strap and retainer plate in both locations.

The recommended tools for this procedure are a No. 2 Phillips screwdriver, an X-acto knife, and a permanent marker.

The replacement parts for this procedure are:

Strap, Velcro
Plate, Retainer, Velcro Strap
Screw, 6-32 x 1/4, Flat Head, Phillips

To replace the Velcro strap and retainer plate, refer to *Figure 7-11*, then proceed as follows:

1. Using the Phillips screwdriver, remove the screw that attaches the Velcro strap and retainer plate to the rear of the pump. Remove the retainer plate and strap.

   Note: If the replacement Velcro strap does not have a hole for the mounting screw, the hole must be cut at the time of installation. Use the defective strap as a template.

2. Replace the retainer plate if damaged.
3. Install the replacement strap and retainer plate using the screw that was removed in step 1.
4. Connect the infusion pump to AC power.

Replacement of the Velcro strap and retainer plate is routine maintenance and no verification procedure is normally required. However, if the infusion pump may have been damaged during this procedure, perform the PVT in *Section 5.2*.

7.3.9.4
POWER SUPPLY PWA REPLACEMENT

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store the PWA in an antistatic bag before placing it on any surface.

The recommended tools for this procedure are a 3/16 inch nutdriver and a 1/4 inch nutdriver.

The replacement parts for this procedure are:

PWA, Power Supply
Shield, Power Supply
Screw, 4-40 x 5/16, Hex Head
Standoff, 4-40, M/F, Hex

To replace the power supply PWA, refer to *Figure 7-13*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Using the 3/16 inch nutdriver, remove the 4-40 screw securing the power supply shield, and fold the shield away from the power supply.
4. Using the 1/4 inch nutdriver, remove the M/F standoff.
5. Disconnect the rear enclosure harness assembly from the power supply PWA.
6. Using the 3/16 inch nutdriver, remove the three 4-40 screws and remove the power supply from the rear enclosure.
7. Remove and inspect the power supply shield and replace if damaged.
8. Install the replacement power supply PWA and power supply shield in the exact reverse order of removal.
9. Connect the infusion pump to AC power.

To verify successful replacement of the power supply PWA, perform the PVT in *Section 5.2*.

7.3.9.5
PAWL/RATCHET ASSEMBLY REPLACEMENT

The recommended tool for this procedure is a 1/4 inch nutdriver.

The replacement parts for this procedure are:

Assembly, Pawl/Ratchet
Screw, 8-32 x 3/8, Hex Head

To replace the pawl/ratchet assembly, refer to *Figure 7-13*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Using the nutdriver, remove the two 8-32 screws securing the pawl/ratchet assembly to the rear enclosure.
4. Lift the pawl/ratchet assembly from the rear enclosure.

5. Install the replacement pawl/ratchet assembly in the exact reverse order of removal.
6. Reassemble the infusion pump in the exact reverse order of disassembly.
7. Connect the infusion pump to AC power.

To verify successful replacement of the pawl/ratchet assembly, perform the PVT in *Section 5.2*.

7.3.9.6

REAR ENCLOSURE HARNESS ASSEMBLY, EQUIPOTENTIAL POST, AND GROUND STRAP REPLACEMENT

Recommended tools for this procedure are diagonal cutters, a set of nutdrivers, and a medium flat head screwdriver.

The replacement parts for this procedure are:

Assembly, Harness, Rear Enclosure	**Nut, Hex, 4-40**
Strap, Ground, Left/Right	**Nut, Hex, 6-32**
Post, Equipotential	**Washer, Lock, #4**
Plate, Nut, Pole Clamp	**Washer, Flat, #4**
Ring, Terminal	**Wrap, Spiral**
Nut, Hex, M6	**Tie, Cable**

To replace the rear enclosure harness assembly, equipotential post, and left and right ground straps, refer to *Figure 7-11*, *Figure 7-12*, or *Figure 7-13*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Using the diagonal cutters, remove the cable ties securing the patient pendant harness to the rear enclosure harness assembly.
4. Remove the power supply shield as described in *Section 7.3.9.4*.
5. Disconnect the rear enclosure harness assembly from the power supply PWA.
6. Using a 10 mm nutdriver, remove the hex nut from the equipotential post.
7. Remove the nut, lock washer, terminal (yellow/green wire), and flat washer from the equipotential post. Remove the equipotential post and replace if damaged.
8. Using a 5/16 inch nutdriver, remove the three 6-32 nuts securing the rear enclosure harness assembly to the pole clamp nut plate.
9. Using a 3/16 inch nutdriver, remove the 4-40 nuts and washers securing the AC connector to the rear enclosure.
10. Remove the rear enclosure harness assembly by carefully pulling it through the rear enclosure.
11. Inspect the left and right ground straps and replace if damaged.
12. Install the replacement rear enclosure harness assembly in the exact reverse order of removal *(see Figure 7-12)*.

    Note: Assure the spiral wrap and cable ties are securely installed on the rear enclosure harness assembly as shown in *Figure 7-12*.

13. Reassemble the infusion pump in the exact reverse order of disassembly.
14. Connect the infusion pump to AC power.

To verify successful replacement of the rear enclosure harness assembly, equipotential post, and ground straps, perform the PVT in *Section 5.2*.

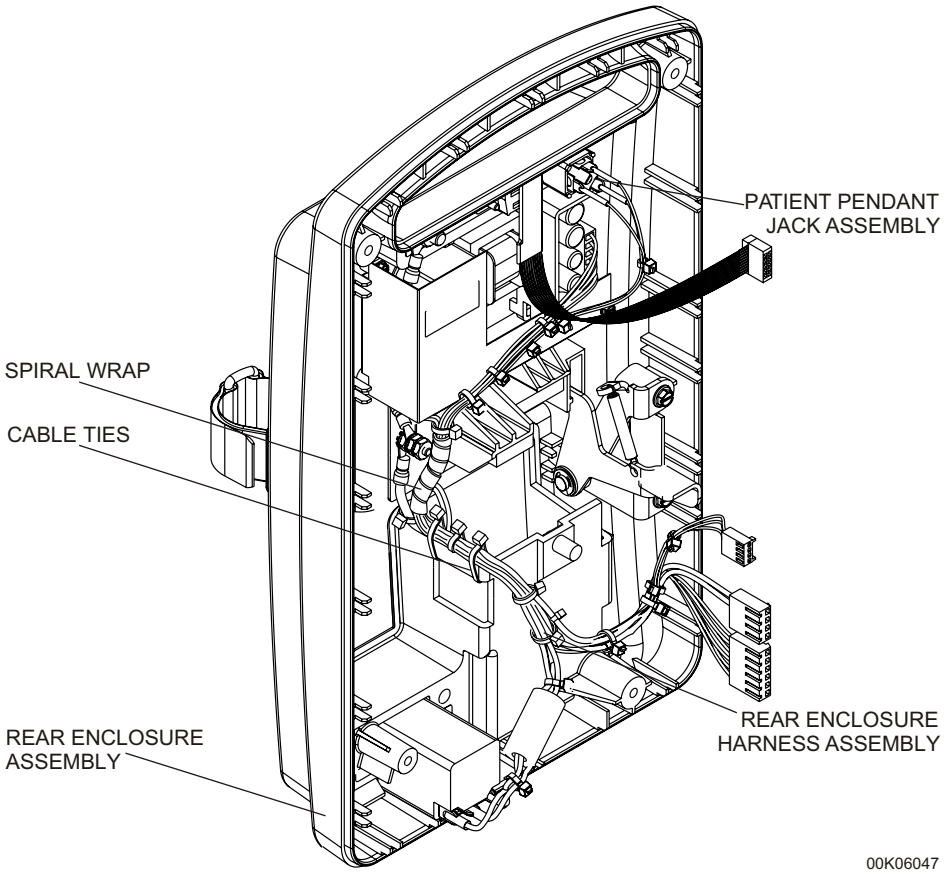

Figure 7-12. Rear Enclosure Harness Assembly

7.3.9.7

BATTERY PAD REPLACEMENT

Recommended tools and materials for this procedure are an X-acto knife, isopropyl alcohol, and a lint-free cloth.

The following replacement part is available:

Pad, Battery

To replace the battery pad, refer to *Figure 7-13*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Using the X-acto knife, carefully remove the battery pad from the rear enclosure.
4. Using a lint-free cloth moistened with isopropyl alcohol, clean any adhesive residue from the enclosure.
5. Remove the protective backing from the replacement battery pad to expose the adhesive and install the pad into the rear enclosure.
6. Reassemble the infusion pump in the exact reverse order of disassembly.
7. Connect the infusion pump to AC power.

To verify successful replacement of the battery pad, perform the PVT in *Section 5.2*.

7.3.9.8
SERIAL PORT CABLE ASSEMBLY REPLACEMENT

The recommended tool for this procedure is a 3/16 inch nutdriver.

The replacement parts for this procedure are:

Assembly, Cable, Serial Port
Seal, Connector, Serial Port
Strap, Ground, Interface Panel
Nut, Hex, 4-40
Washer, Lock, #4
Screwlock, 4-40, M/F, Hex

To replace the serial port cable assembly, refer to *Figure 7-11* and *Figure 7-13*, then proceed as follows:

1. Disconnect the infusion pump from AC power.
2. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
3. Using the nutdriver, remove the nuts and lock washers from the screwlock posts.
4. Using the nutdriver, remove the screwlocks securing the 9 pin serial port connector to the rear enclosure assembly *(see Figure 7-11)*.
5. Inspect the serial port connector seal and interface panel ground strap and replace, if damaged. Transfer the seal to the replacement serial port cable assembly *(see Figure 7-13)*.
6. Install the replacement serial port cable assembly using the screwlocks, nuts, and washers that were removed in step 3 and step 4.
7. Reassemble the infusion pump in the exact reverse order of disassembly.
8. Connect the infusion pump to AC power.

To verify successful replacement of the serial port cable assembly, perform the PVT in *Section 5.2*.

7.3.9.9

PATIENT PENDANT JACK ASSEMBLY REPLACEMENT

Recommended tools for this procedure are a 1/2 inch nutdriver, diagonal cutters, and cable ties.

The replacement parts for this procedure are:

Assembly, Jack, Patient Pendant
Tie, Cable

To replace the patient pendant jack assembly, refer to *Figure 7-12* and *Figure 7-13*, then proceed as follows:

Disconnect the infusion pump from AC power.

1. Separate the front and rear enclosure assemblies as described in *Section 7.2.2*.
2. Using the nutdriver, remove the retainer nut and flat washer that attach the patient pendant jack to the rear enclosure.
3. Using the diagonal cutters, remove the cable ties that secure the patient pendant jack assembly to the rear enclosure harness assembly.
4. Remove the spiral wrap and the patient pendant jack assembly from the pump.
5. Install the replacement patient pendant jack assembly in the exact reverse order of removal.

   Note: Secure the patient pendant jack harness to the rear enclosure harness assembly with the spiral wrap and cable ties as shown in *Figure 7-12*.

6. Reassemble the infusion pump in the exact reverse order of disassembly.
7. Connect the infusion pump to AC power.

To verify successful replacement of the patient pendant jack assembly, perform the PVT in *Section 5.2*.

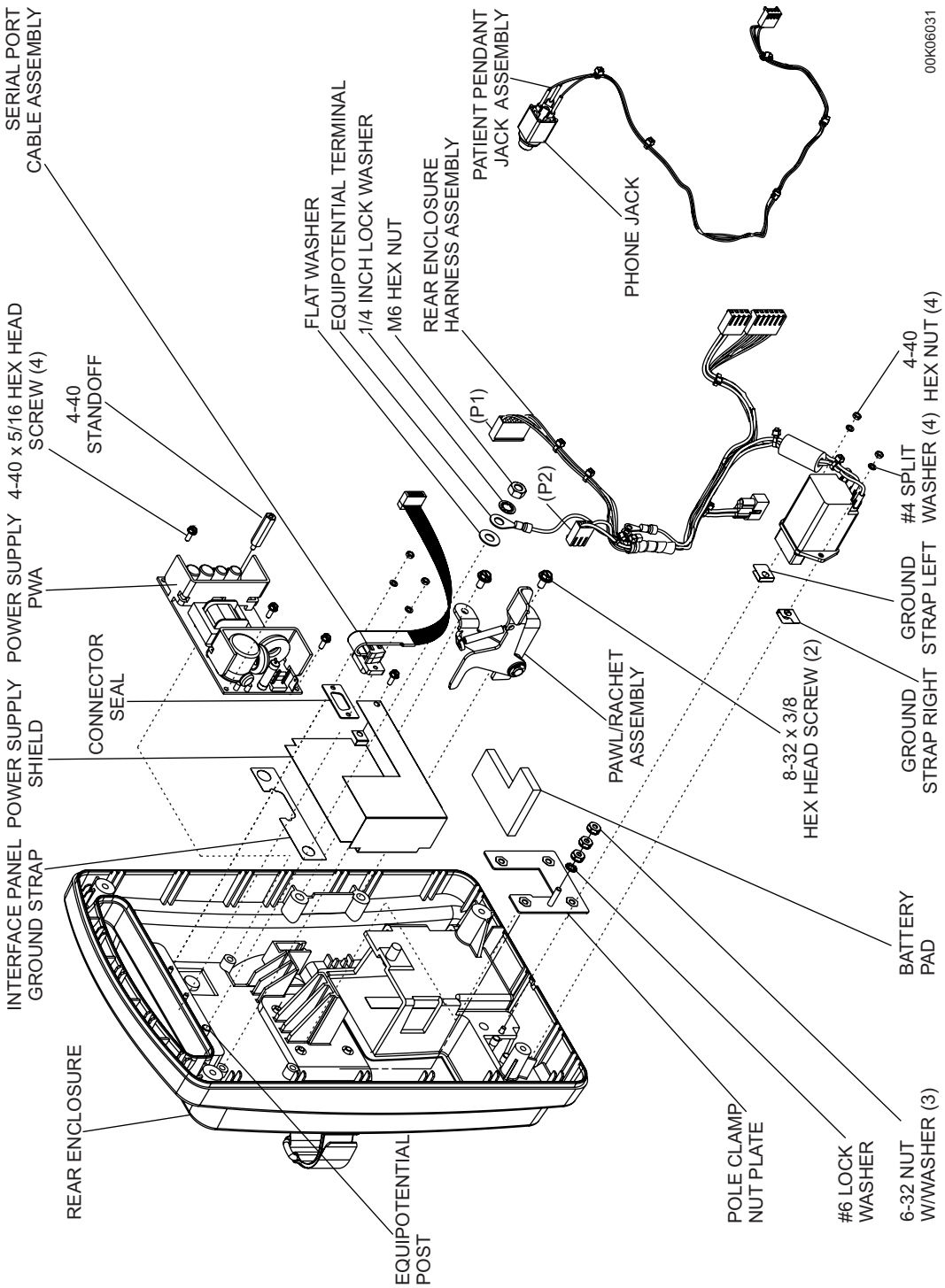

Figure 7-13. Rear Enclosure Internal Components

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Section 8

SPECIFICATIONS

PHYSICAL

Dimensions: Approximately 8 in. W x 13 in. H x 6 in. D (excluding pole clamp and power cord)

Weight: Approximately 10 lbs. with battery

Casing: High-impact plastic

ELECTRICAL

Power Requirements: 105-130 V, 57 - 63 Hz, 50 W

Power Cord: Hospital-grade AC cord. 10 feet with transparent plug and retainer plate

Fuses: 0.5 A, 250 V, Slo-Blo

Battery: One sealed lead acid, rechargeable 8 V battery, internal to the device

Battery Operation: A fully charged new battery provides four hours of operation and delivers 30 mL of solution. Operation time is measured from initial pumping to the LOW BATTERY alarm.

Recharge: The battery charges whenever the infusion pump is connected to AC power. After a LOW BATTERY alarm, the battery will recharge to 80% of full capacity within 16 hours.

Self-Discharge: A fully charged battery will retain a minimum 20% of the initial charge for six months when the infusion pump is not connected to AC power or is not operating, and is stored at 20° C.

ENVIRONMENT

Operating: 41° to 104° F (5° to 40° C) 10% to 90% relative humidity

Transporting and Storage: -4° to 140° F (-20° to 60° C) 10% to 90% relative humidity

Atmospheric Pressure: 0 - 10,000 feet (0 - 3000 meters) or equivalent atmospheric pressure

Relative Humidity: 10 - 90% non-condensing up to 104° F (40° C); maximum of 15% non-condensing above 104° F (40° C)

OCCLUSION ALARM AND LIMITS

Backpressure Range: 10 to 20 psi

MODES

PCA Only: Approximately 1 mL in 35 seconds

Continuous Only: Variable from 0.1 x concentration to 20 x concentration (mg/hr or mcg/hr)

PCA + Continuous: Variable from 0.1 x concentration to 20 x concentration (mg/hr or mcg/hr)

Lockout Interval Range: 5 to 120 minutes in one minute increments

Section 9
DRAWINGS

Figure 9-1 through *Figure 9-9* show the illustrated parts breakdown (IPB), infusion pump assembly diagrams, and PWA schematic diagrams. *Table 9-1, Drawings*, lists drawings by figure number, title, and part number. *Table 9-2, Illustrated Parts Breakdown*, identifies parts by index numbers which correlate to *Figure 9-1*.

Note: Drawings and schematics in *Section 9* are provided as information only. Drawings and schematics may not exactly reflect current product configuration.

Table 9-1. Drawings

Figure No.	Title	Part Number
9-1	Illustrated Parts Breakdown (2 Sheets)	Not Applicable
9-2	Final Assembly (1 Sheet)	
9-3	Front Enclosure Assembly (2 Sheets)	
9-4	Rear Enclosure Assembly (2 Sheets)	
9-5	Electronics Assembly (1 Sheet)	
9-6	Mechanism Assembly (1 Sheet)	
9-7	MCU PWA Schematic (6 Sheets)	249-04505
9-8	Numeric Display Schematic (1 Sheet)	249-04506
9-9	Icon Display Schematic (1 Sheet)	249-04507

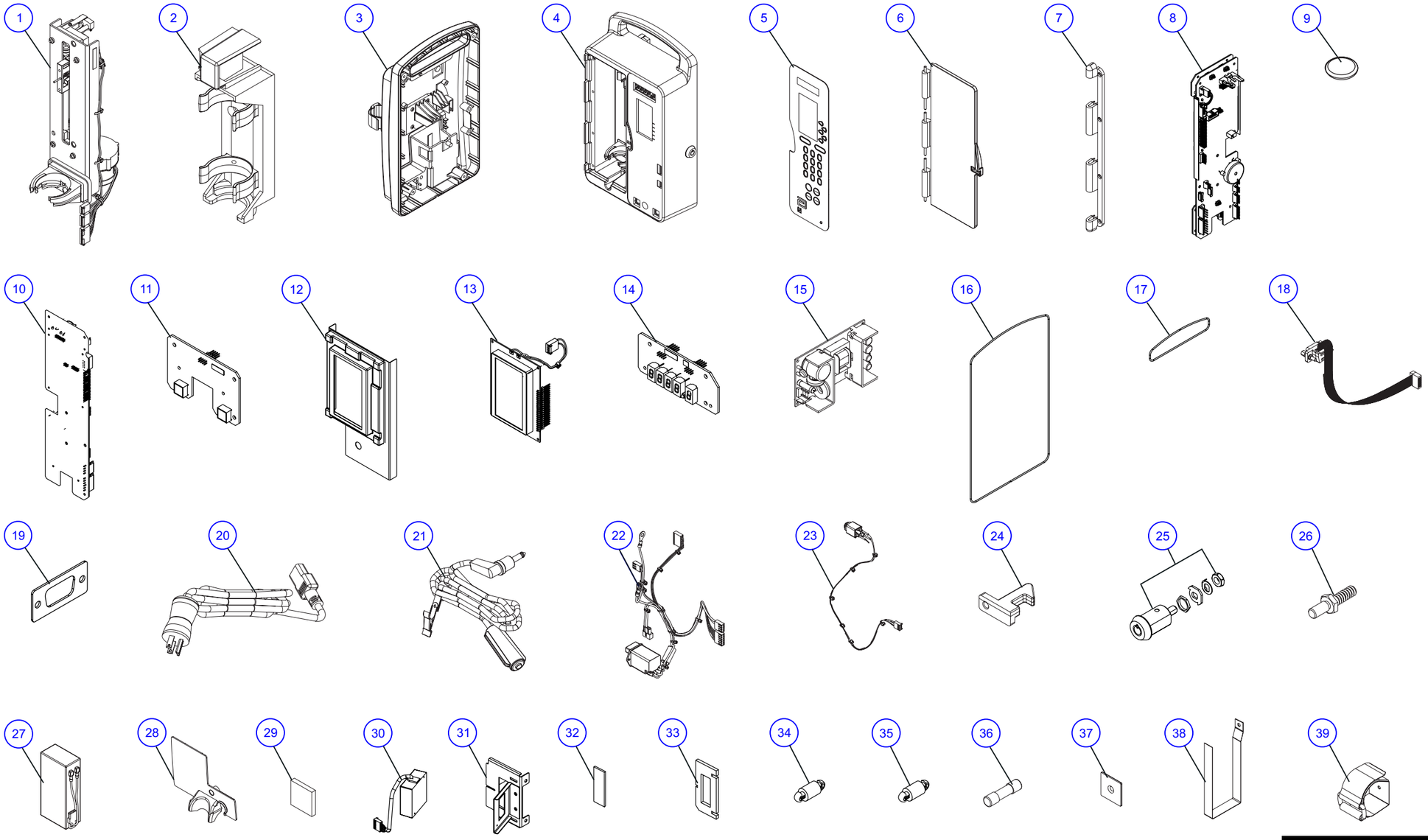
Table 9-2. Illustrated Parts Breakdown

Index No.	Nomenclature	Replacement Procedure
1	Assembly, Mechanism	*Section 7.3.8.12*
2	Assembly, Cradle	*Section 7.3.8.4*
3	Enclosure, Rear	*Section 7.3.3*
4	Enclosure, Front	*Section 7.3.3*
5	Keypad	*Section 7.3.8.2*
6	Door, Security	*Section 7.3.8.1*
7	Hinge, Security Door	*Section 7.3.8.1*
8	Assembly, Electronics	*Section 7.3.8.9*
9	Battery, Lithium	*Section 7.3.8.10.6*

Table 9-2. Illustrated Parts Breakdown		
Index No.	**Nomenclature**	**Replacement Procedure**
10	PWA, MCU	*Section 7.3.8.10.5*
11	PWA, Icon Display	*Section 7.3.8.10.4*
12	Shield, LCD	*Section 7.3.8.10.1*
13	Assembly, LCD	*Section 7.3.8.10.2*
14	PWA, Numeric Display	*Section 7.3.8.10.3*
15	PWA, Power Supply	*Section 7.3.9.4*
16	Gasket, Enclosure	*Section 7.3.8.8*
17	Gasket, Handle	*Section 7.3.8.8*
18	Assembly, Cable, Serial Port	*Section 7.3.9.8*
19	Seal, Connector, Serial Port	*Section 7.3.9.8*
20	Cordset, AC Power, Hospital Grade	*Section 7.3.5*
21	Assembly, Patient Pendant	*Section 7.3.7*
22	Assembly, Harness, Rear Enclosure	*Section 7.3.9.6*
23	Assembly, Jack, Patient Pendant	*Section 7.3.9.9*
24	Hook, Door Latch	*Section 7.3.8.3*
25	Assembly, Door Lock	*Section 7.3.8.7*
26	Post, Equipotential	*Section 7.3.9.6*
27	Assembly, Battery, w/Wire Harness	*Section 7.3.6*
28	Door, Battery	*Section 7.3.6*
29	Pad, Battery Door	*Section 7.3.6*
30	Reader, Barcode	*Section 7.3.8.13*
31	Bracket, Barcode Reader	*Section 7.3.8.13*
32	Window, Barcode Reader	*Section 7.3.8.13*
33	Gasket, Barcode Reader	*Section 7.3.8.13*
34	Post, Nylon, 6 mm/Post, Nylon, 1/4	As applicable
35	Post, Nylon, 8 mm/Post, Nylon, 5/16	As applicable
36	Fuse, .5 A, 250 V, Slo-Blo	*Section 7.3.9.1*
37	Plate, Retainer, Velcro Strap	*Section 7.3.9.3*
38	Strap, Battery	*Section 7.3.6*
39	Strap, Velcro	*Section 7.3.9.3*
40	Shield, Splash	*Section 7.3.8.14*

Table 9-2. Illustrated Parts Breakdown		
Index No.	**Nomenclature**	**Replacement Procedure**
41	Pad, Battery	*Section 7.3.9.7*
42	Window, LCD	*Section 7.3.8.11*
43	Assembly, Door Latch	*Section 7.3.8.6*
44	Assembly, Pawl/Ratchet	*Section 7.3.9.5*
45	Assembly, Pole Clamp	*Section 7.3.9.2*
46	Arm, Lever, Mechanism	*Section 7.3.8.5*
47	Strap, Ground, Right	*Section 7.3.9.6*
48	Strap, Ground, Left	*Section 7.3.9.6*
49	Bracket, Grounding, Keypad	*Section 7.3.8.2*
50	Pad, Rubber Foot	*Section 7.3.4*
51	Pad, Foam	*Section 7.3.8.9*
52	Plate, Nut, Pole Clamp	*Section 7.3.9.6*
53	Strap, Ground, Interface Panel	*Section 7.3.9.8*
54	Shield, Power Supply	*Section 7.3.9.4*
55	Washer, Lock, Conical, External Tooth, #8	As applicable
56	Washer, Lock, External Tooth, #6, SS	As applicable
57	Washer, Split, Lock, #6	As applicable
58	Washer, Split, Lock, Helical	As applicable
59	Washer, Lock, 1/4, .025 Thick, Internal Tooth	As applicable
60	Washer, Lock, #4, SS	As applicable
61	Washer, Flat, .566 x .255 x .030 Thick, SS	As applicable
62	Ring, Terminal	*Section 7.3.9.6*
63	Screw, 8-32 x 3/8, Hex Head, w/Washer	As applicable
64	Screw, 8-32 x 1/2, Flat Head, Phillips	As applicable
65	Screw, 10-32 x 1 3/4, Hex Head, w/Washer	As applicable
66	Screw, 10-32 x 1, Hex Head, w/Washer	As applicable
67	Screw, 4-40 x 3/16, Flat Head, Phillips	As applicable
68	Screw, 4-40 x 3/8, Pan Head, Phillips	As applicable
69	Screw, 4-40 x 5/16, Hex Head, Slotted	As applicable
70	Screw, 4-24 x 3/8, Thread Cutting, Phillips	As applicable
71	Screw, 6-24 x 5/8, Pan Head, Phillips	As applicable

Table 9-2. Illustrated Parts Breakdown		
Index No.	**Nomenclature**	**Replacement Procedure**
72	Screw, 6-32 x 1/4, Flat Head, Phillips	As applicable
73	Screw, 6-32 x 1/4, Pan Head, Phillips	As applicable
74	Screw, 6-32 x 1/2, Pan Head, Phillips	As applicable
75	Screw, 6-32 x 5/16, Hex Head, w/Washer	As applicable
76	Nut, M6, Hex, SS	*Section 7.3.9.6*
77	Nut, 6-32, Hex, Cad/Zinc, w/Washer	As applicable
78	Nut, 4-40, Hex, Cad/Zinc, Small Serrated	As applicable
79	Screwlock, 4-40, M/F, Hex	*Section 7.3.9.8*
80	Standoff, 4-40, M/F, Hex	*Section 7.3.9.4*
81	Wrap, Spiral	*Section 7.3.9.6*
82	Tie, Cable	*Section 7.3.9.6* *Section 7.3.9.9*



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HOSPIRA, INC.	
Figure 9-1. Illustrated Parts Breakdown	
DRAWING NO.	Rev. N/A
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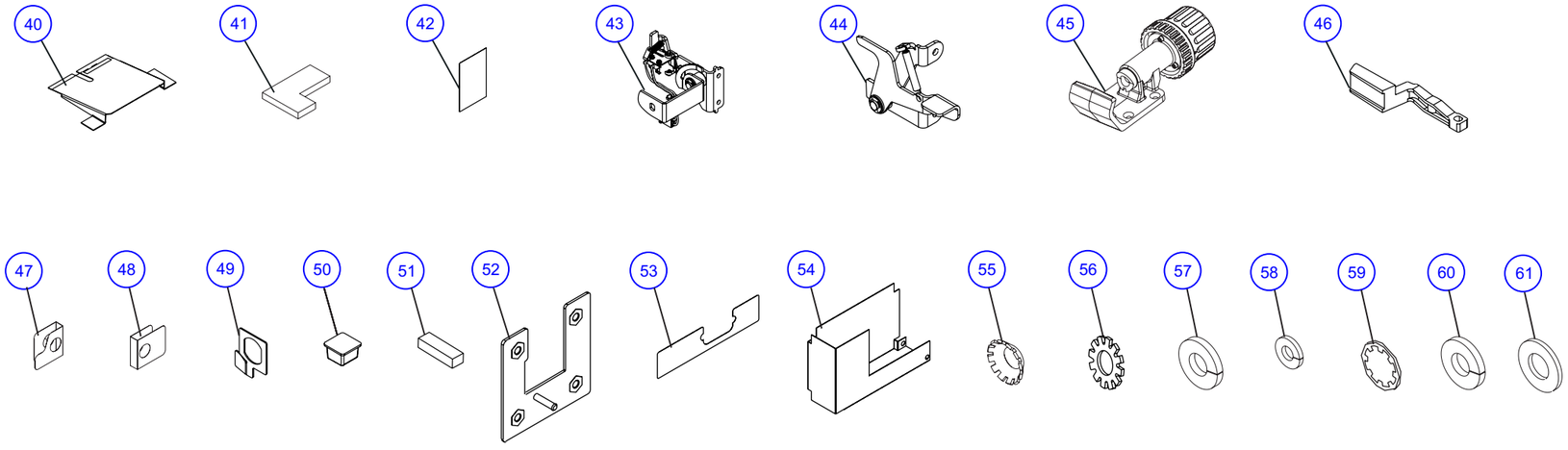

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HOSPIRA, INC.	
Figure 9-1. Illustrated Parts Breakdown	
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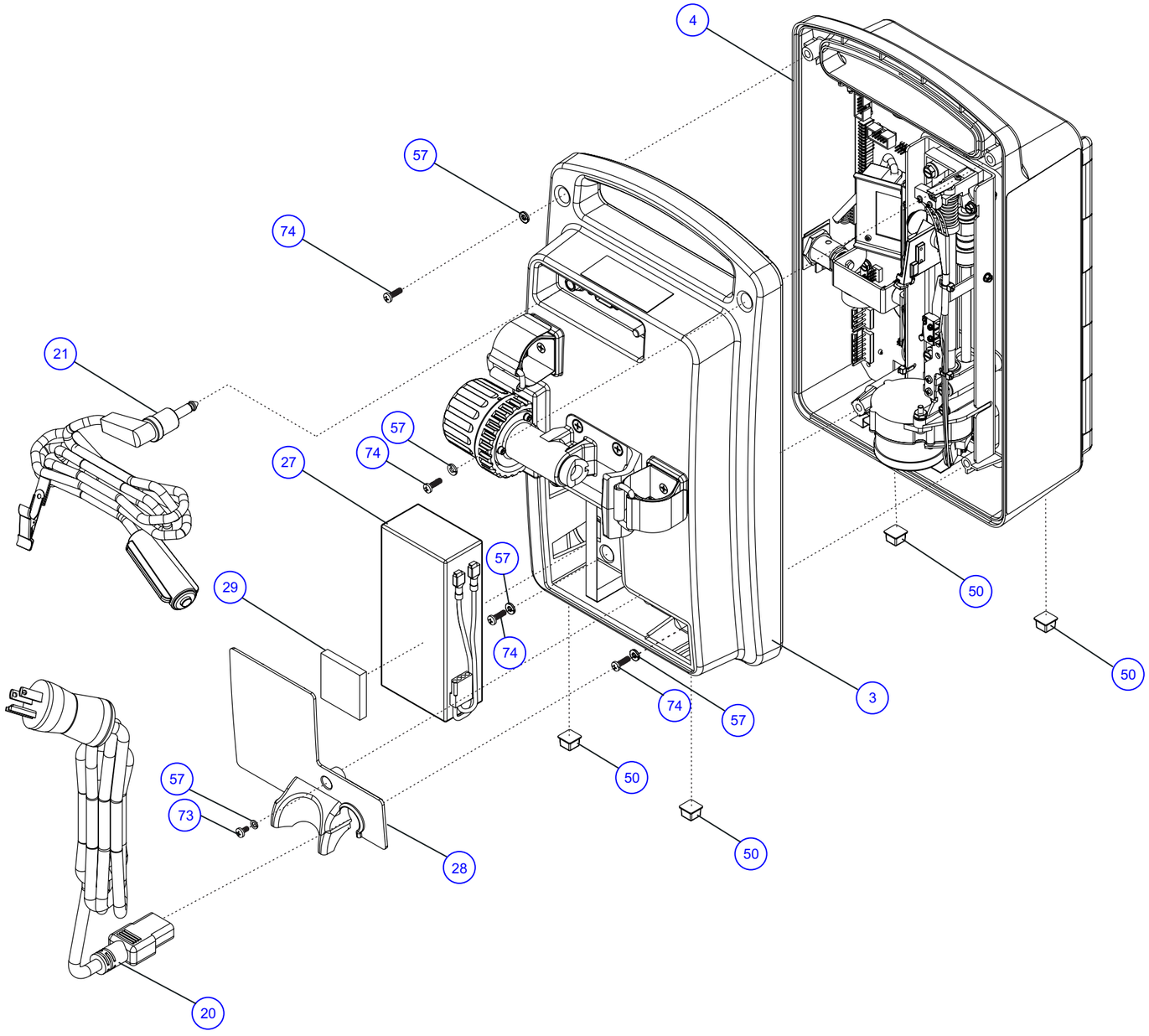

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HOSPIRA, INC.	
Figure 9-2. Final Assembly	
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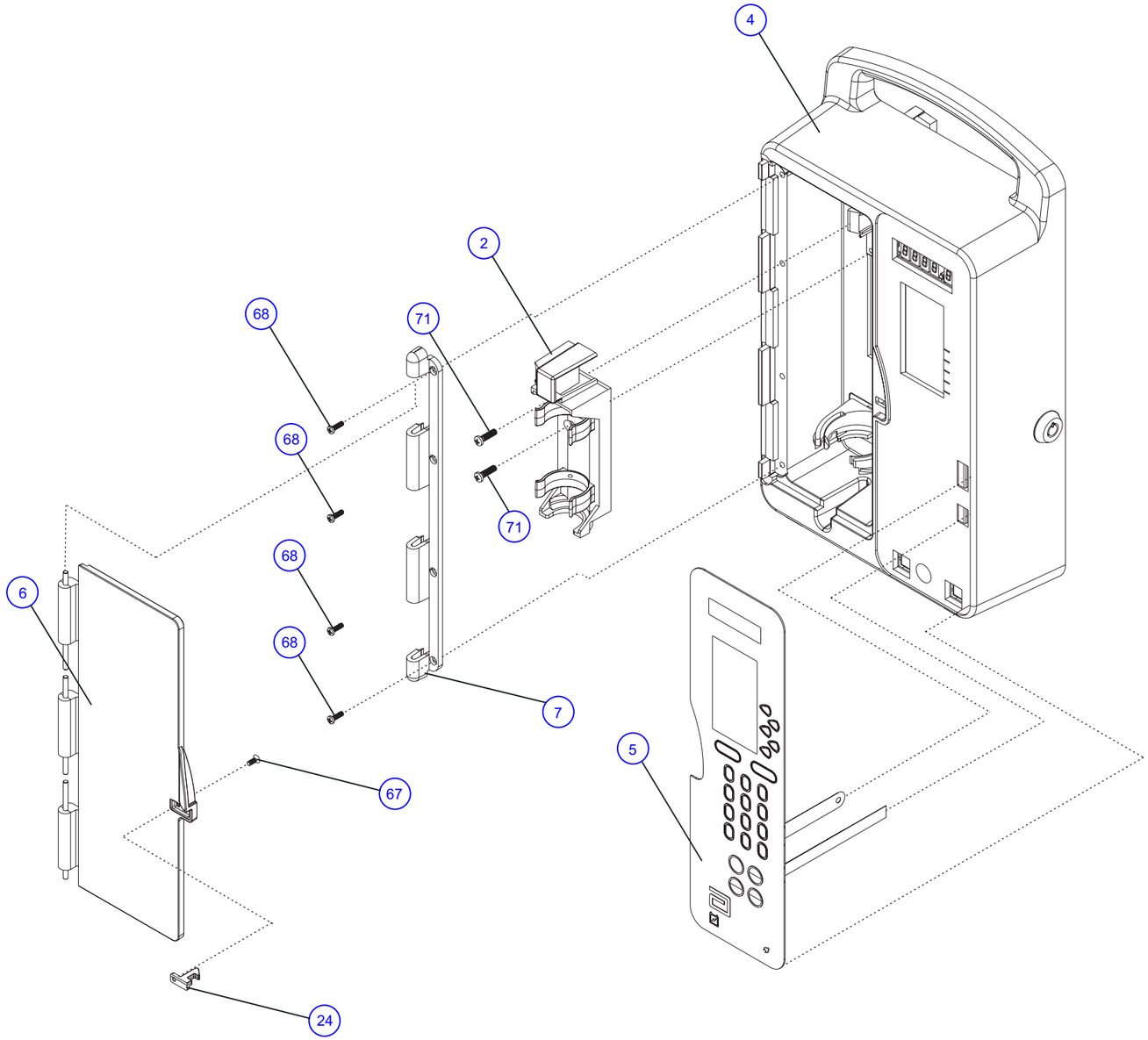

HOSPIRA, INC.	
Figure 9-3. Front Enclosure Assembly	
DRAWING NO.	Rev. N/A
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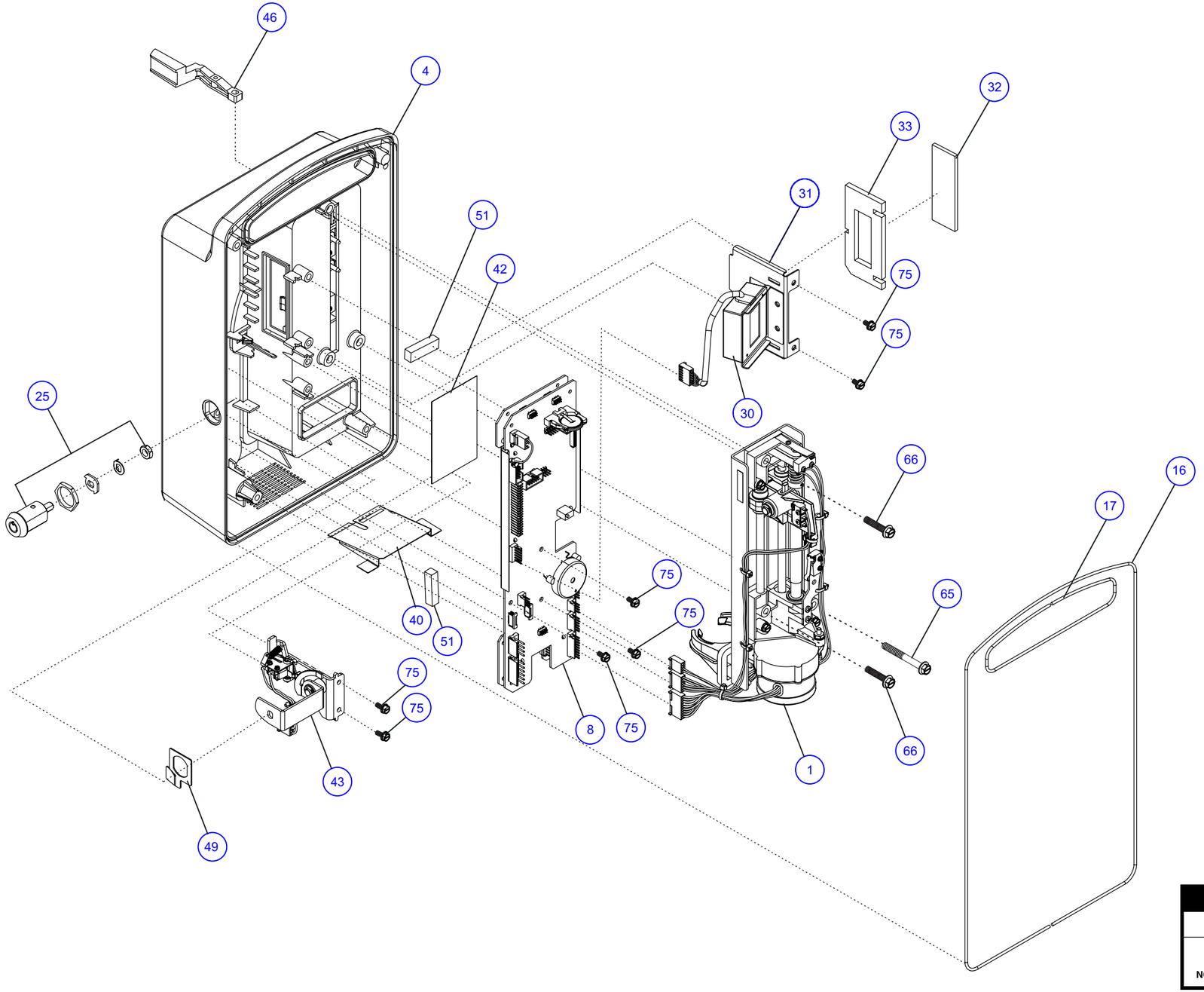

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HOSPIRA, INC.	
Figure 9-3. Front Enclosure Assembly	
DRAWING NO.	Rev. N/A
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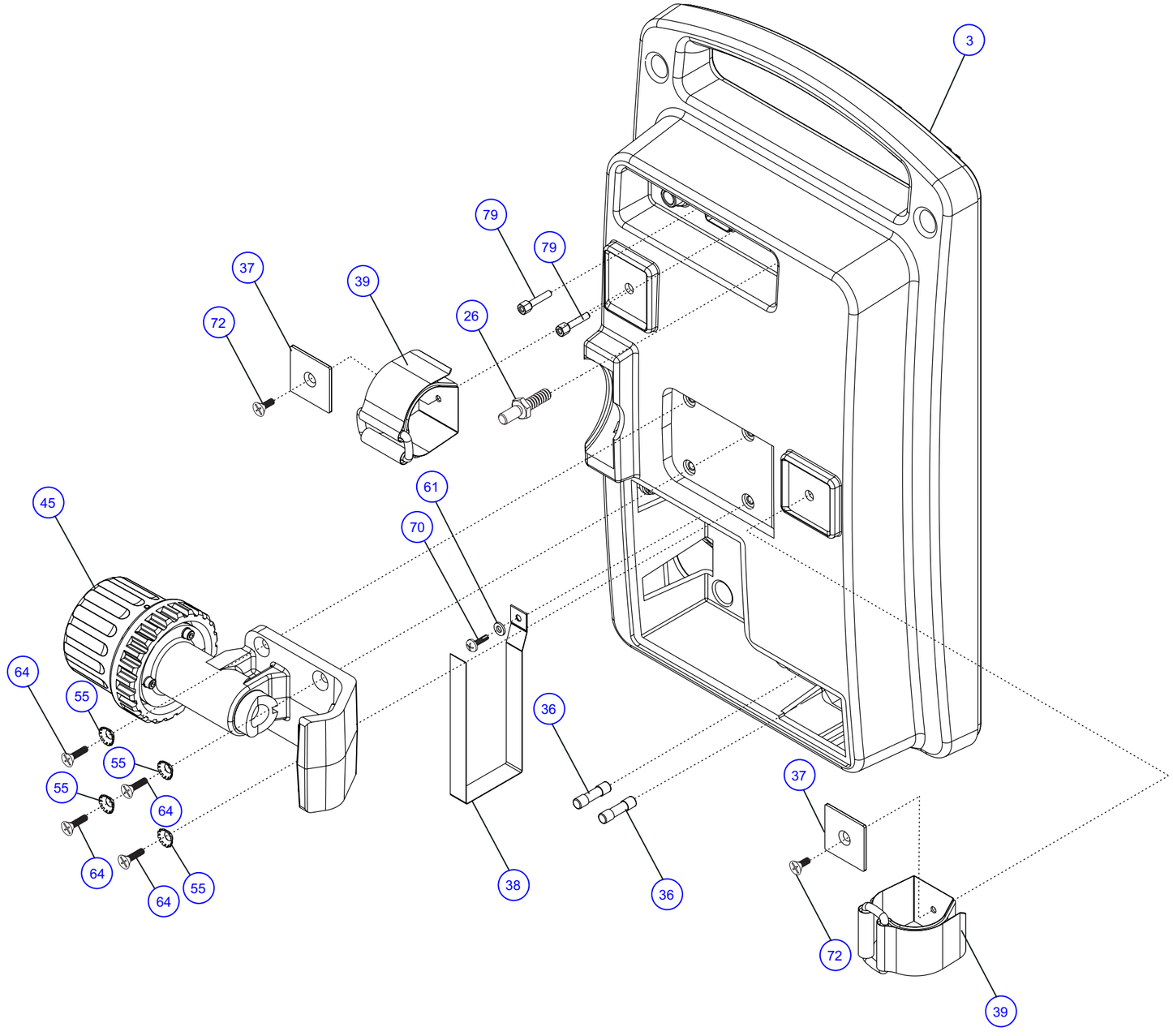

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HOSPIRA, INC.	
Figure 9-4. Rear Enclosure Assembly	
DRAWING NO.	Rev. N/A
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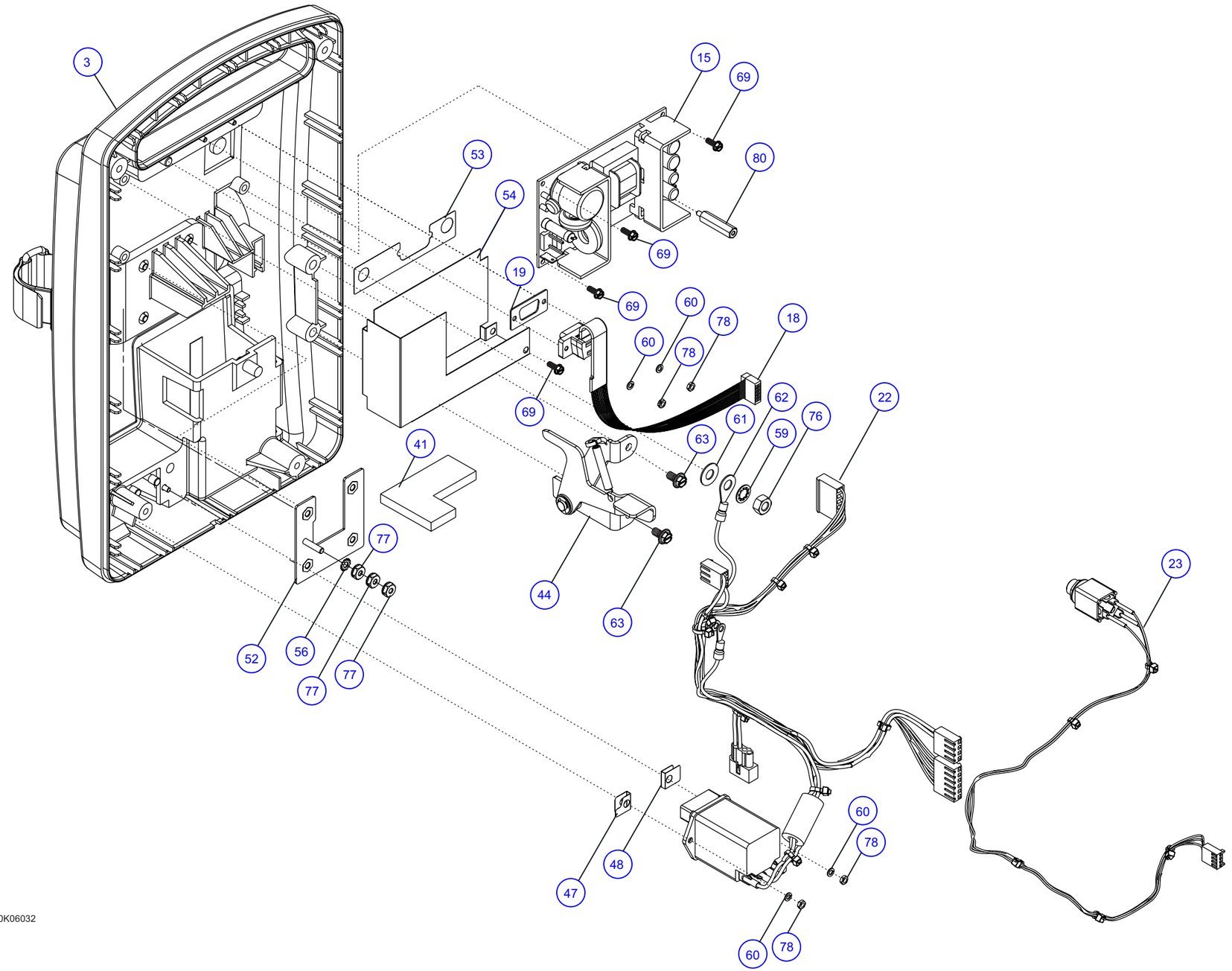

HOSPIRA, INC.	
Figure 9-4. Rear Enclosure Assembly	
DRAWING NO.	Rev. N/A
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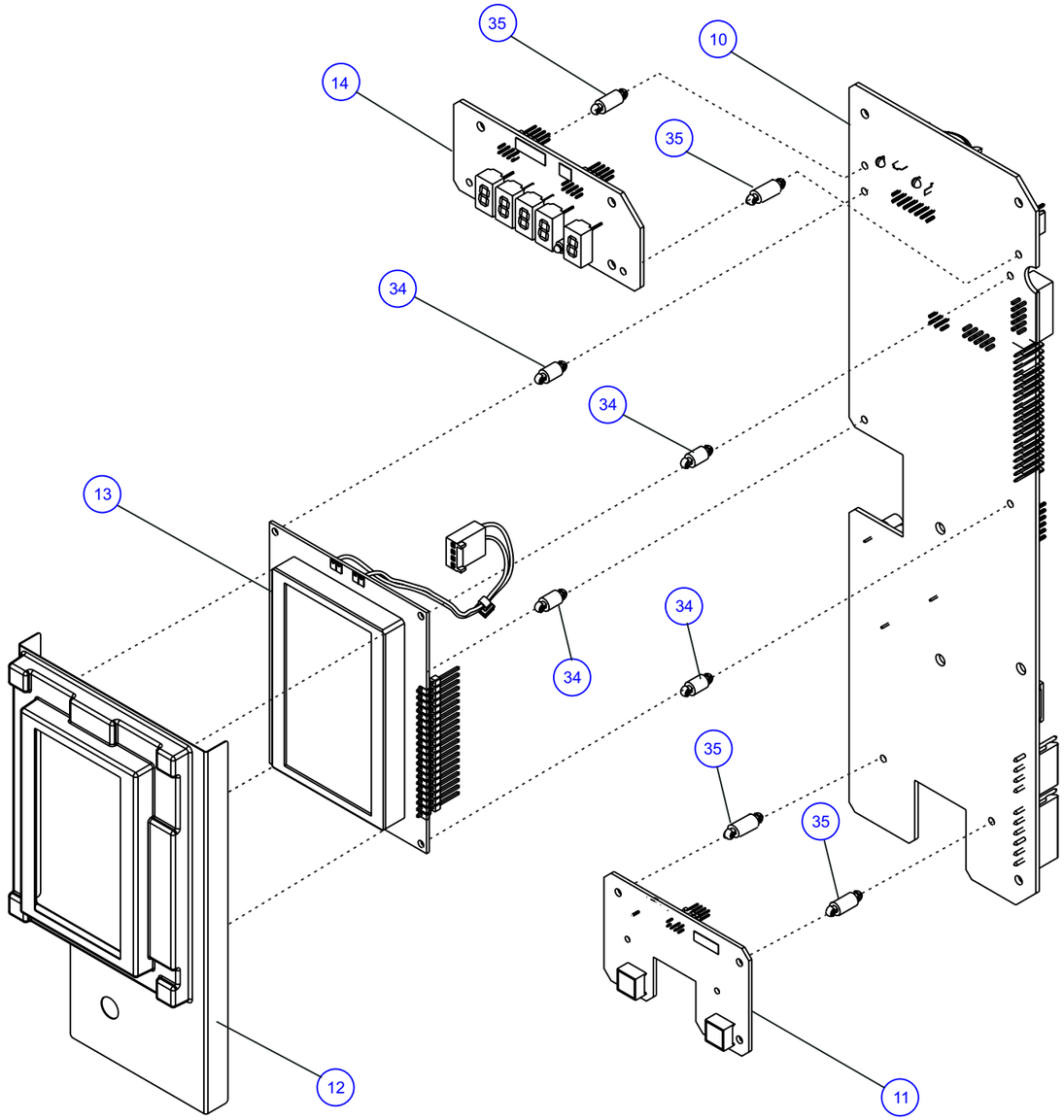

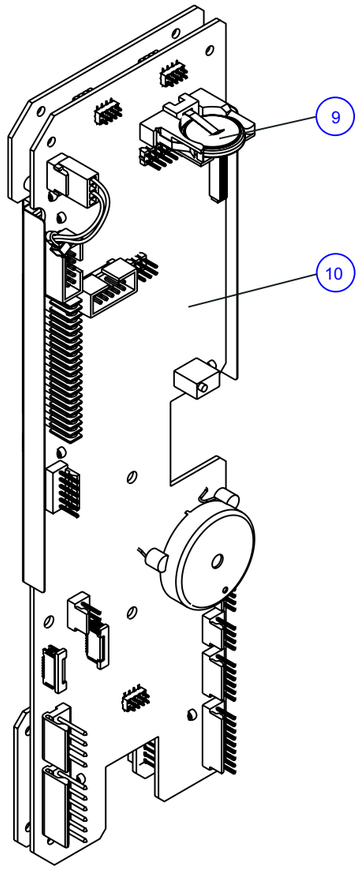

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HOSPIRA, INC.	
Figure 9-5. Electronics Assembly (XLM with DataPort - Domestic)	
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NOT APPLICABLE	Sheet 1 of 1

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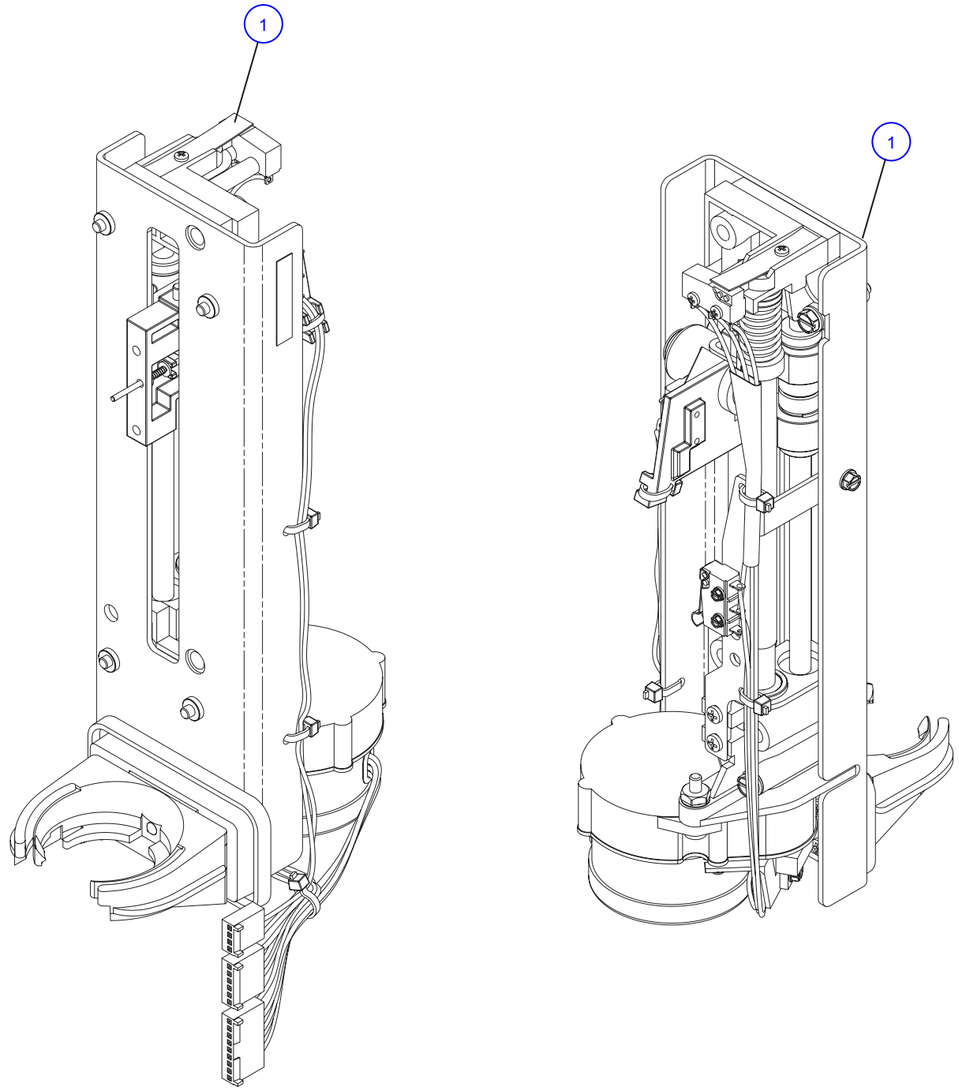

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HOSPIRA, INC.	
Figure 9-6. Mechanism Assembly	
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NOT APPLICABLE	Sheet 1 of 1

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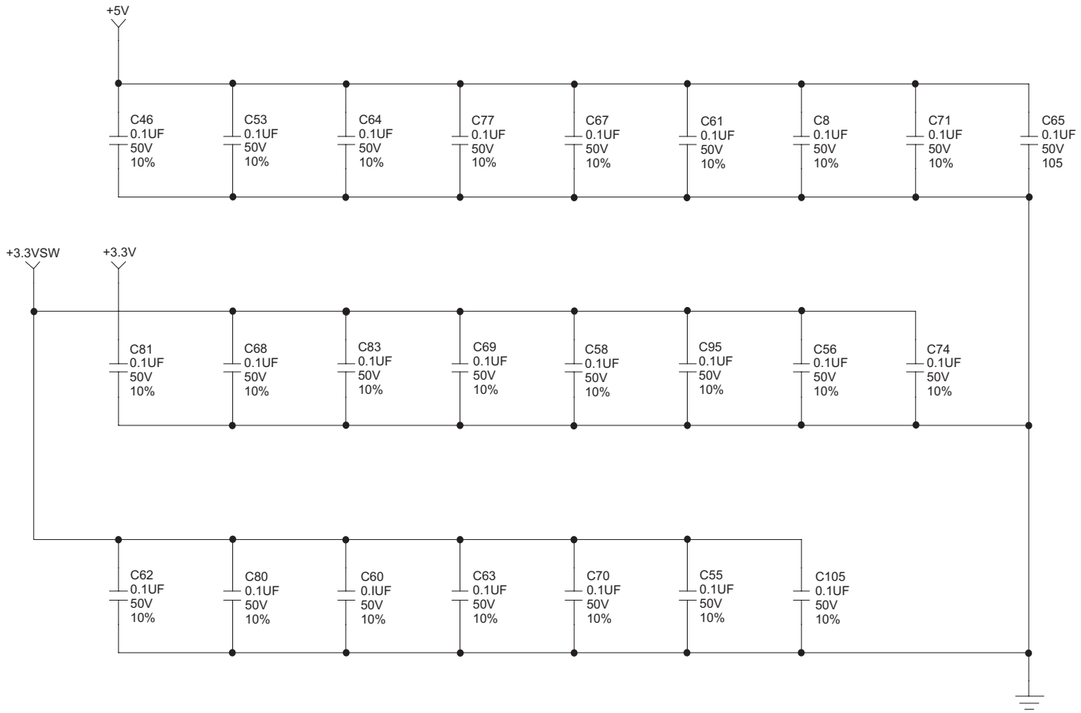

HOSPIRA, INC.	
Figure 9-7. MCU PWA Schematic	
DRAWING NO.	Rev. A
249-04505-005	Sheet 1 of 6

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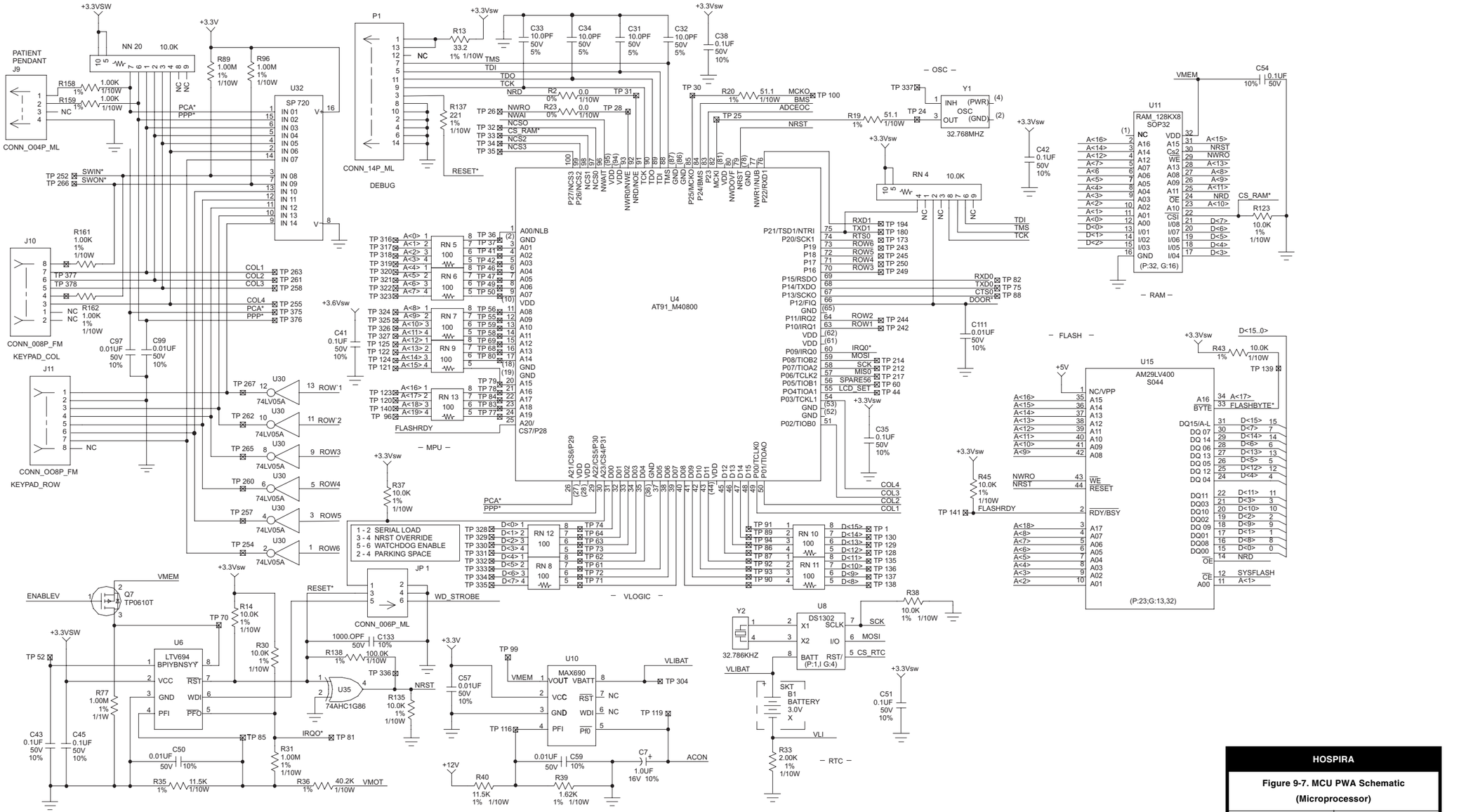
PATIENT PENDANT J9
CONN_O04P_ML
KEYPAD_COL
CONN_008P_FM
KEYPAD_ROW
CONN_OO8P_FM
SP 720
U32
P1
CONN_14P_ML
DEBUG
RESET*
U4
AT91_M40800
– OSC –
Y1
32.768MHZ
– RAM –
U11
RAM_128KX8
SOP32
– FLASH –
U15
AM29LV400
S044
– MPU –
– VLOGIC –
– RTC –
U6
LTV694
BPIYBNSYY
U10
MAX690
U35
74AHC1G86
U8
DS1302
Y2
32.786KHZ
BATTERY
3.0V
JP 1
CONN_006P_ML
1 - 2 SERIAL LOAD
3 - 4 NRST OVERRIDE
5 - 6 WATCHDOG ENABLE
2 - 4 PARKING SPACE
74LV05A
TP0610T
+3.3VSW
+3.3V
+3.3Vsw
+3.6Vsw
+5V
+12V
VMEM
VLIBAT
ACON
WD_STROBE
ENABLEV
IRQ0*
SWIN*
SWON*
PCA*
PPP*
NRST
CS_RAM*
FLASHRDY
TMS
TDI
TDO
TCK
SCK
MOSI
CS_RTC
ROW 1
ROW 2
ROW 3
ROW 4
ROW 5
ROW 6
COL1
COL2
COL3
COL4
RXD0
TXD0
CTS0
DOOR*
RXD1
TXD1
RTS0
ROW5
ROW4
ROW3
ROW6
MCKO
BMS
ADCEOC
NWRO
NRST
FLASHBYTE*
SYSFLASH
D<15..0>
A00/NLB
A20/ CS7/P28
A21/CS6/P29
A22/CS5/P30
A23/CS4/P31
P00/TCLK0
P01/TIOA0
P02/TIOB0
P20/SCK1
P21/TSD1/NTRI
P22/RXD1
P24/BMS
P25/MCKO
P27/NCS3
P28/NCS2
NCS1
NCS0
NWAIT
NWR0/NWE
NRD/NOE
P12/FIQ
P11/IRQ2
P10/IRQ1
P09/IRQ0
P08/TIOB2
P07/TIOA2
P06/TCLK2
P05/TIOB1
P04TIOA1
P03/TCKL1
P15/RSDO
P14/TXDO
P13/SCKO
RESET
RDY/BSY
DQ15/A-L
DQ 07
DQ 14
DQ 06
DQ 13
DQ 05
DQ 12
DQ 04
DQ11
DQ03
DQ10
DQ02
DQ 09
DQ01
DQ08
DQ00
OE
CE
A00
R13 33.2 1% 1/10W
R137 221 1% 1/10W
R2 0.0 1/10W
R23 0.0 1/10W
R20 51.1 1/10W
R19 51.1 1/10W
R89 1.00M 1% 1/10W
R96 1.00M 1% 1/10W
R158 1.00K 1/10W 1%
R159 1.00K 1/10W
R161 1.00K 1% 1/10W
R162 1.00K 1% 1/10W
NN 20 10.0K
RN 4 10.0K
RN 5 100
RN 6 100
RN 7 100
RN 9 100
RN 13 100
RN 12 100
RN 8 100
RN 10 100
RN 11 100
R123 10.0K 1% 1/10W
R43 10.0K 1% 1/10W
R45 10.0K 1% 1/10W
R38 10.0K 1% 1/10W
R14 10.0K 1% 1/10W
R30 10.0K 1% 1/10W
R135 10.0K 1% 1/10W
R77 1.00M 1% 1/1W
R31 1.00M 1% 1/10W
R35 11.5K 1% 1/10W
R36 40.2K 1% 1/10W
R40 11.5K 1% 1/10W
R39 1.62K 1% 1/10W
R33 2.00K 1% 1/10W
R138 100.0K 1% 1/10W
C33 10.0PF 50V 5%
C34 10.0PF 50V 5%
C31 10.0PF 50V 5%
C32 10.0PF 50V 5%
C38 0.1UF 50V 10%
C54 0.1UF 10% 50V
C42 0.1UF 50V 10%
C111 0.01UF 50V 10%
C35 0.1UF 50V 10%
C51 0.1UF 50V 10%
C97 0.01UF 50V 10%
C99 0.01UF 50V 10%
C41 0.1UF 50V 10%
C43 0.1UF 50V 10%
C45 0.1UF 50V 10%
C50 0.01UF 50V 10%
C133 1000.0PF 50V 10%
C57 0.01UF 50V 10%
C59 0.01UF 50V 10%
C7 1.0UF 16V 10%
HOSPIRA
Figure 9-7. MCU PWA Schematic (Microprocessor)
DRAWING NO. 249-04505-005
Rev. A
Sheet 2 of 6

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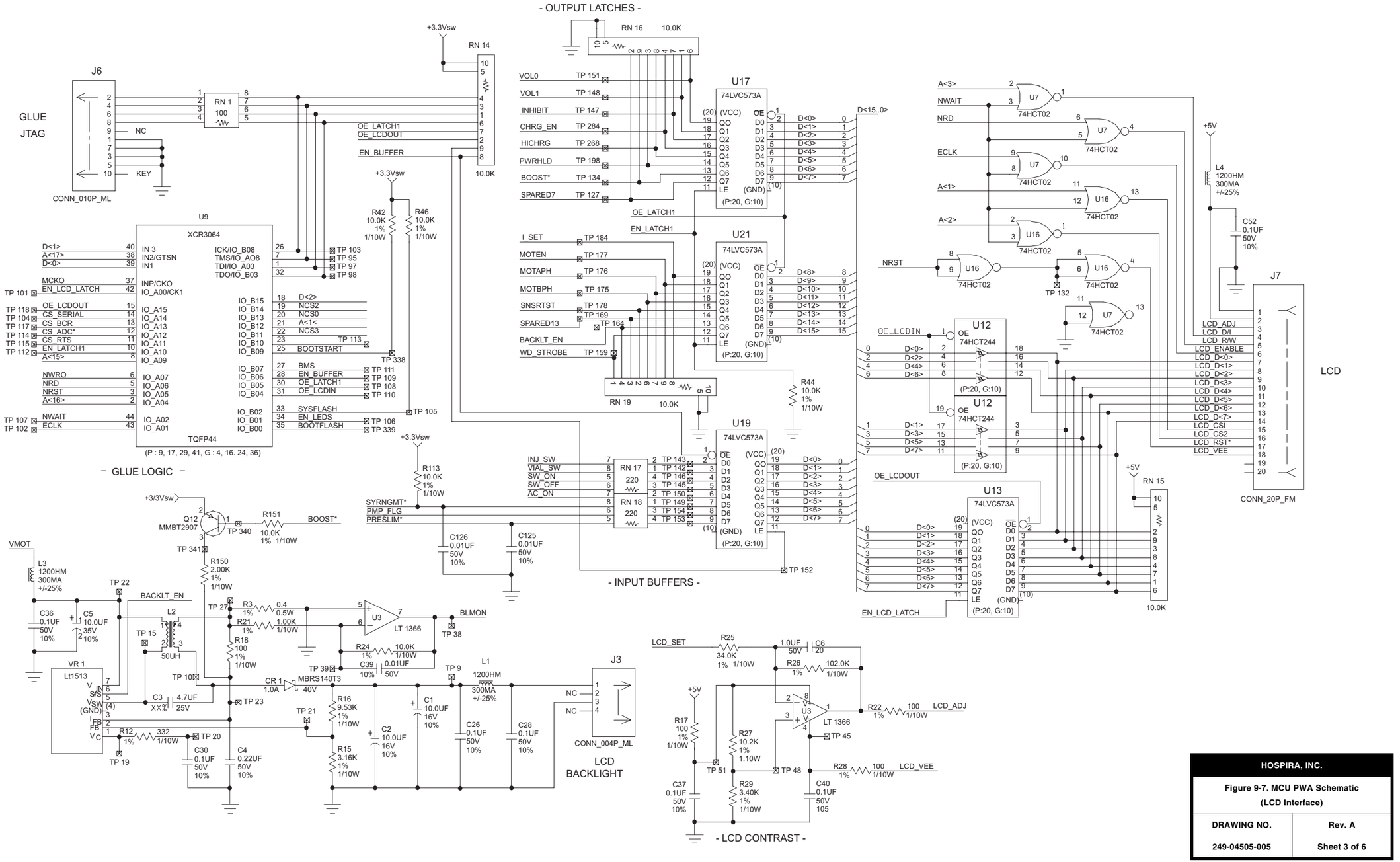

HOSPIRA, INC.	
Figure 9-7. MCU PWA Schematic (LCD Interface)	
DRAWING NO.	Rev. A
249-04505-005	Sheet 3 of 6

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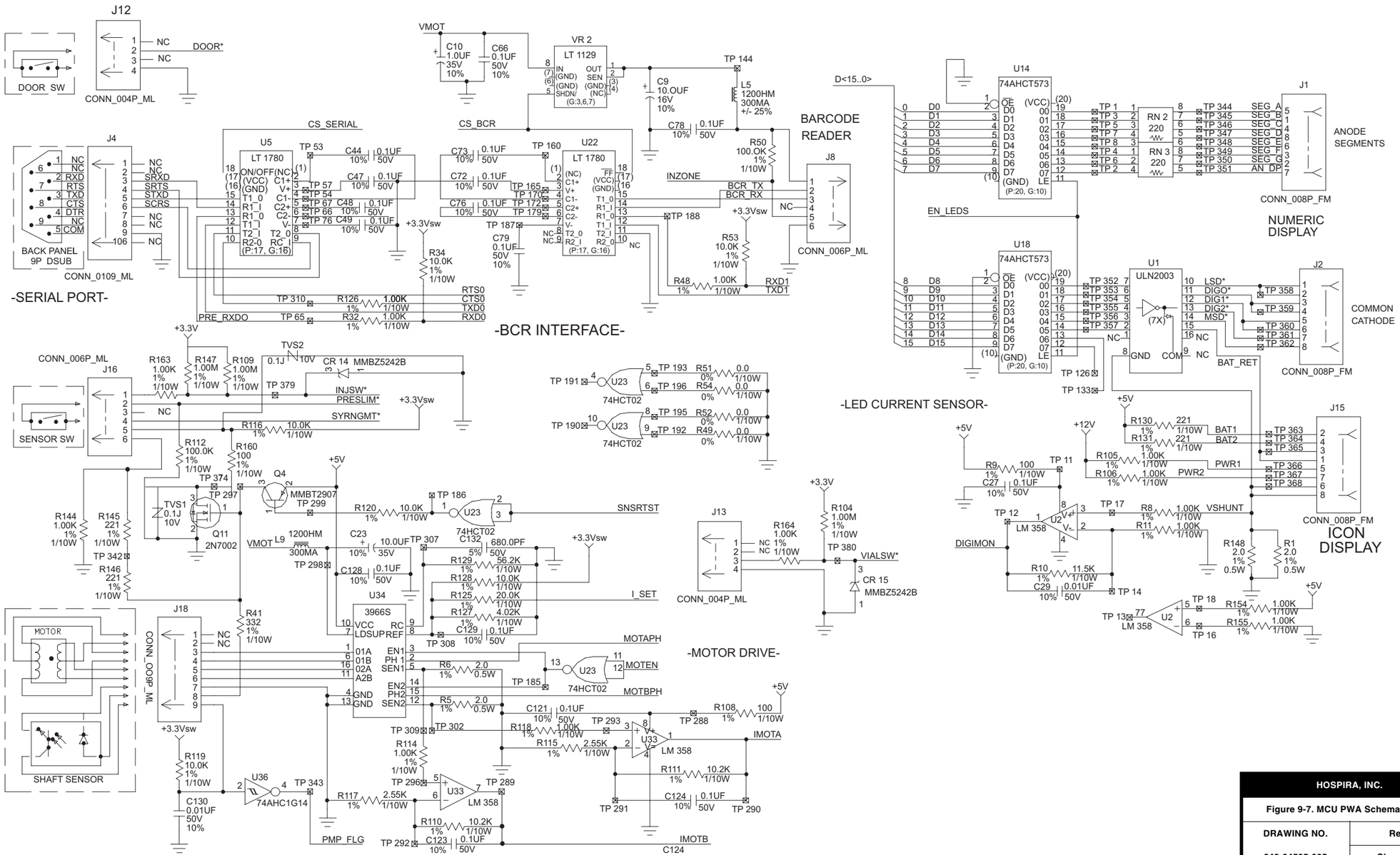

HOSPIRA, INC.	
Figure 9-7. MCU PWA Schematic (I/O)	
DRAWING NO.	Rev. A
249-04505-005	Sheet 4 of 6

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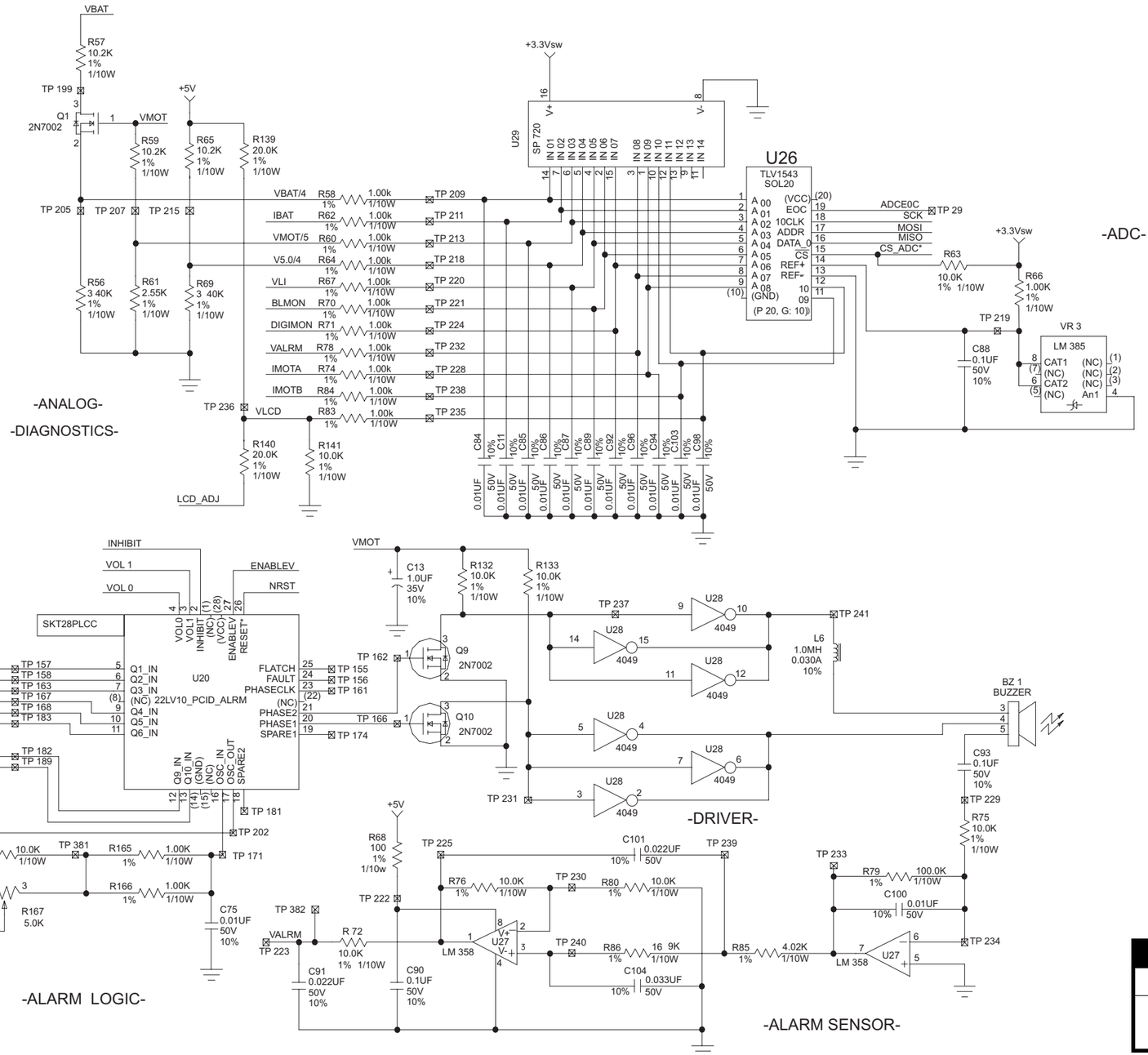

HOSPIRA, INC.	
Figure 9-7. MCU PWA Schematic (Analog)	
DRAWING NO.	Rev. A
249-04505-005	Sheet 5 of 6

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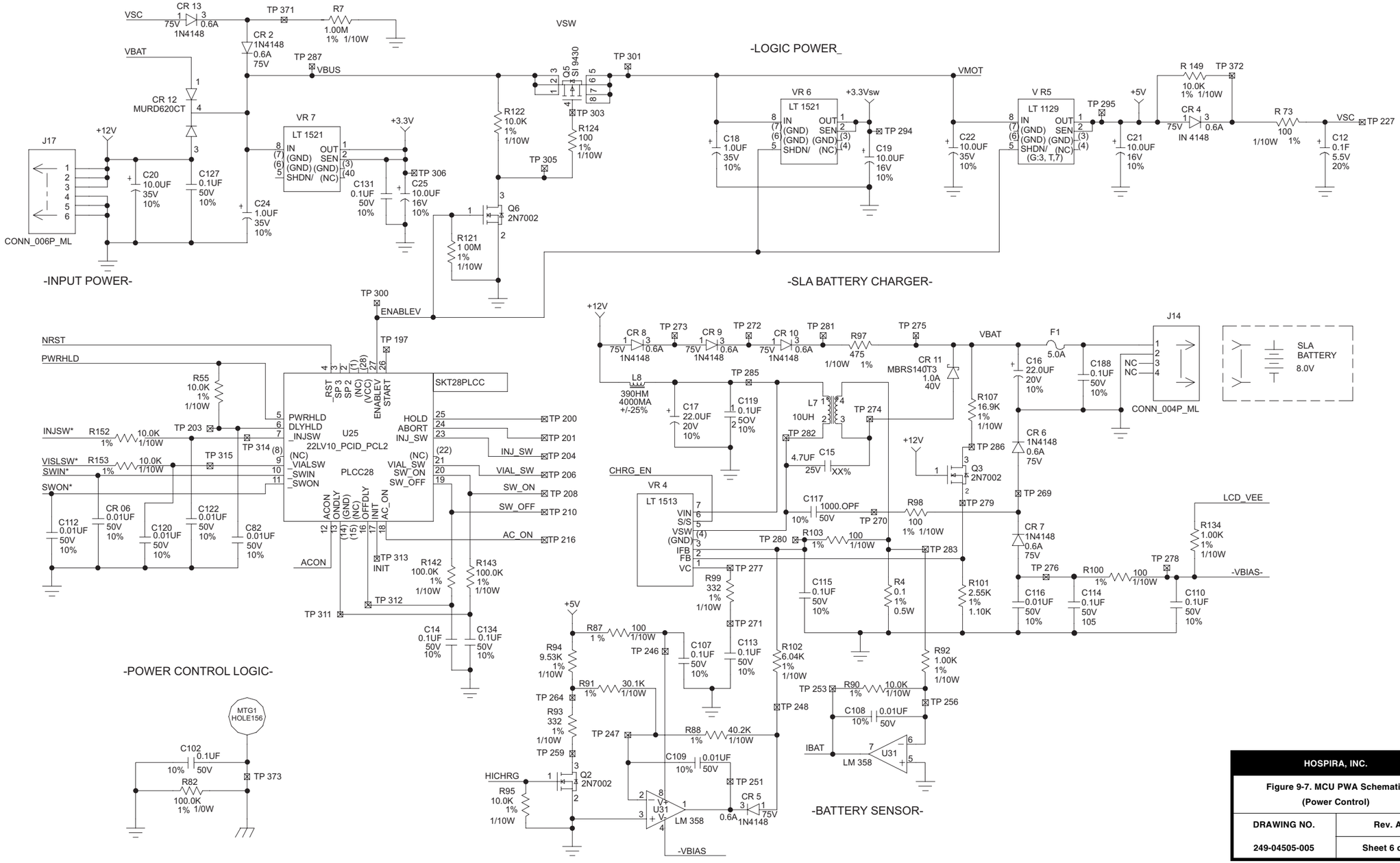

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Figure 9-7. MCU PWA Schematic (Power Control)	
DRAWING NO.	Rev. A
249-04505-005	Sheet 6 of 6

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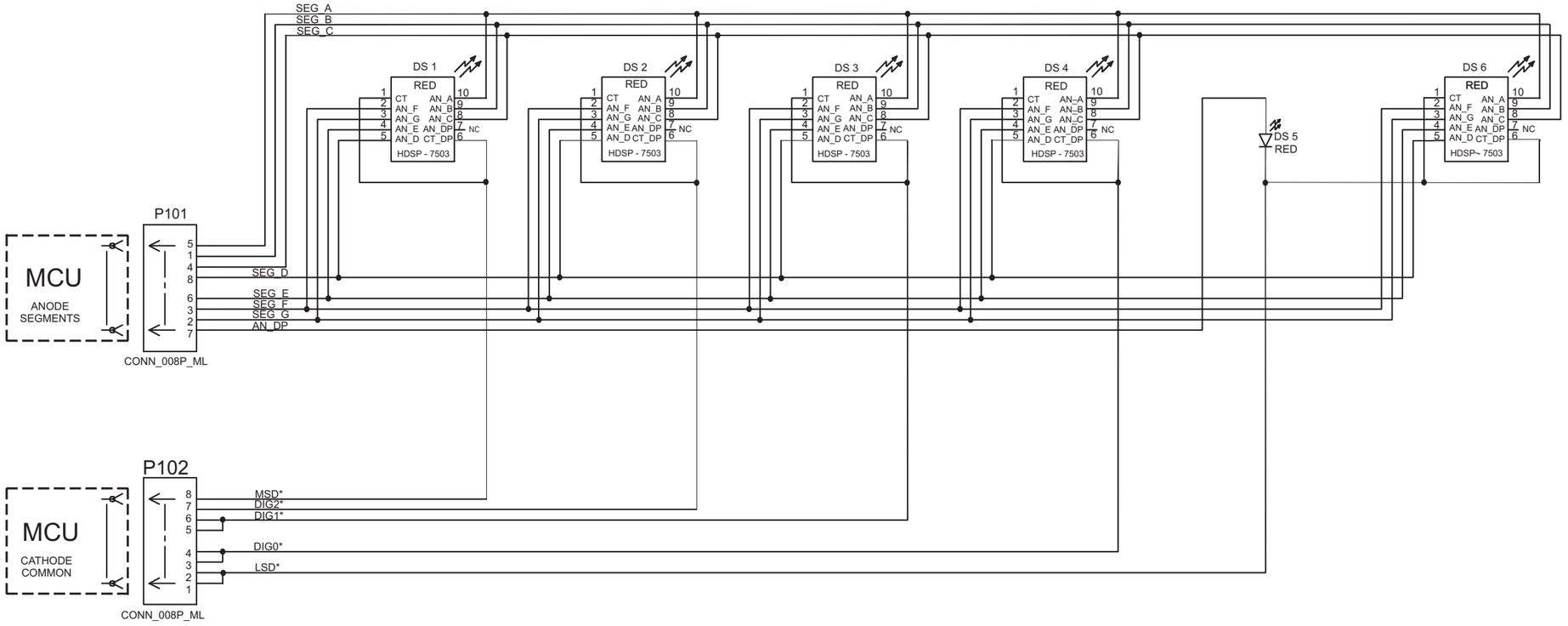

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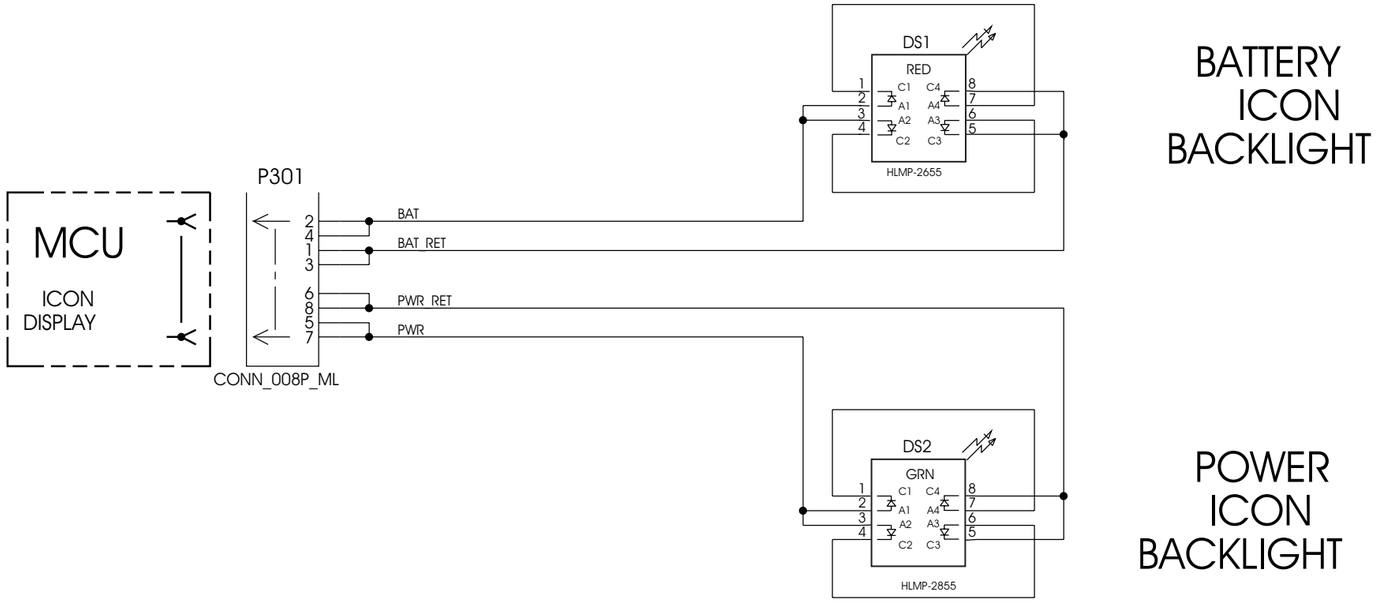

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